Christmas Party Lights to Build

SILICON CHIP

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Hybrid Vehicles Are Here!

WINDOWS XP:

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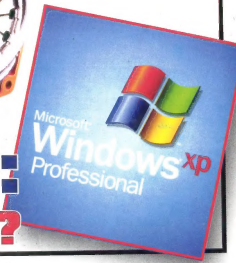

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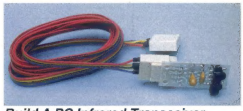

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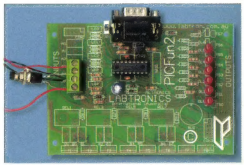

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PUBLISHER'S LETTER

Copyright is the lifeblood of a magazine

Copyright for software, films and music is often in the news but not so often as far as magazines are concerned. People often think that large corporations protecting their copyright are being greedy but the truth is that copyright is a "right". Copyright is owned by the company or person who originally produced or paid for the material and they have every right to be paid for it.

Which brings us to SILICON CHIP. Silicon Chip Publications Pty Ltd, the publisher of this magazine, is not a large corporation but a small Australian family-owned company. Yet it is subject to exactly the same attacks on its copyright every day. Countless thousands of people regularly photocopy articles or scan the magazine rather than buy their own copy from the newsagent. Photocopying is rife in municipal libraries, schools, TAFE colleges, universities and businesses, and virtually every copy made means a lost sale of the magazine.

Yes, we do get an annual payment from the Copyright Agency Limited for photocopying in schools and TAFEs but it is really small – absolutely ludicrous.

Why am I writing this? Because I am constantly confronted by people who think that we should provide all sorts of information for free, especially via the Internet. Some people even think that the magazine should be much cheaper and would be if we printed on recycled paper. How little they know. The fact is that producing a magazine like SILICON CHIP is very labour intensive. "Labour intensive" means that there are lots of wages and contributors' fees to be paid, on top of printers' bills, distribution costs and so on. And nor is recycled paper cheaper; it is dearer.

We also frequently see requests on Internet newsgroups for scans of SILICON CHIP articles. It is nice to know that the articles are popular but how do these people think the magazine is supposed to survive in the long run if everything is being done for free? If you get a request from someone for a copy of an article in your SILICON CHIP, please politely refuse. We need their support, as well as yours. Thanks.

While I am constantly aware of all of this, it has been highlighted recently by the closure of "Electronics Australia" after over 70 years of publication. When we started SILICON CHIP, in 1987, there were three other electronics magazines: EA, ETI (Electronics Today International) and AEM (Australian Electronics Monthly) and heaps of imported magazines. Now there is just one Australian electronics magazine and that is SILICON CHIP.

There are probably many reasons why the other three magazines ceased publication but first and foremost must be a gradual loss in their circulation over the years. And a significant part of the loss of circulation is inevitably due to photocopying. It is "death by a thousand cuts".

Fortunately, SILICON CHIP is viable and is here for the long term. Since we are produced by a family company and not by a large corporation, we are not subject to the often arbitrary pruning that occurs in large organisations when times are tougher. But we still need your support to grow and flourish and this means more people buying (yes, paying for) the magazine at the newsagent or via a subscription.

So if you are one of those people who often photocopies articles in other peoples' magazines or from library copies, please think about your actions. Don't leave it to other people to pay for the magazine, buy it yourself.

In the overall scheme of things, magazines are cheap; $6.60, the cost of this magazine, does not buy much else, not even a family pizza.

Leo Simpson

MAILBAG

Pearce Simpson CB manual wanted

Let me first congratulate you and your staff on your excellent magazine of which I have never missed a copy.

I have a problem that you or your readers may be able to help me with. I recently purchased an Hatadi Pearce Simpson UHF CB transceiver Model Leopard Mk2: SN301848 and requested from the supplier, Hatadi Electronics, a technical manual and circuit diagram. I received a reply from Brightpoint Aust. Pty Ltd telling me that they had taken over Hatadi and no longer had anything to do with CB radios and therefore were unable to help me.

Could anyone help me with these or an address of a Pearce Simpson agent (NZ or Australia) to whom I could write? Or perhaps someone could supply the manual and circuit diagram direct.

A. Plimley, 100 Parawai Road, Thames, New Zealand.

"Mantel" vs "Mantle"

Thank you so much (once again) for providing us with a "real" Australian electronics magazine. It's good to see that Jim Rowe and others have joined your team of authors.

Sorry to be a bit nit-picky but would you please tell Rodney Champness (in the nicest possible way, after a large thank-you for his articles on Vintage Radio) that the sort of radio he is referring to is spelled "mantel", not "mantle".

Like mantel clocks, they sit on a mantelpiece.

David Pulford, Forestville, NSW.

Marconi signal generator on offer

I have an old Marconi AM Signal Generator, Type TF 801A/1, which covers from 10-310MHz at 75Ω, with a 100dB switched attenuator, plus handbook.

Before I scrap this, I thought it might be of interest to a collector, avid shortwave listener or a vintage radio enthusiast. If it is, I will be happy for them to collect it from the address below.

M. Benyon, 61/27 Rangers Road, Cremorne, NSW 2001. Phone (02) 9953 5216.

In defence of DVD

I would like to come to the defence of DVD which has come in for a bagging in recent letters. In the letter by Brad Sheargold (October 2001), he stated that his friend's new Fujitsu monitor was 1.5m wide and running at 1,000,000 * 1,000,000 pixels in XVGA mode.

In the first case, the largest plasma display that Fujitsu make is the PDS4221/PDS4222 which is 1035mm wide with a screen width of 920mm and a pixel resolution of 1024 * 1024. I find it interesting that it was running in XVGA mode. Does this mean it was connected to a computer running with a DVD player? In that case, did the computer have a hardware or software decoder for the DVD signal, as software decompression does not produce anywhere near the quality of a hardware decoder.

As for requiring a $US8000 to $US10,000 player to get a decent picture, I have a $329 Omni player that produces excellent picture quality on a standard 68cm TV – far in excess of that from VHS. Indeed the picture quality is that much better that my wife, who usually shakes her head at my 'toys', commented on the difference and allowed me to buy a new 5.1 sound system to complement the picture.

In the email by Simon Kareh (September 2001), he states that when he watched a movie in widescreen mode that the heads were cropped. I have a number of doubled-sided DVDs with one side in widescreen and the other in normal (or 4:3). Since his email, I have reviewed all these and in all cases the 4:3 picture removed the side part of the picture (ie, a narrower view) while in widescreen there was no such cropping.

The widescreen ratio is that which

continued next page

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is seen at a movie theatre and I hear no complaint about heads being cropped. Additionally, PAL/SECAM DVD movies are encoded at 720 * 576 while NTSC are encoded at 720 * 480. So based on his 56% lines available, this would be 322 lines which is a significant improvement over VHS with 250.

John Richardson (October 2001) has missed an important point when he says that 44% of the bandwidth is taken up with the black bars. MPEG compression works by only recording those sections of a picture that have changed from one frame to the next. So even if the black bars are transmitted they do not take up bandwith as there as been no change.

I have numerous friends with DVD players and all have agreed with my comment regarding quality. As far as owning DVD discs is concerned, at present I own approximately 180 compared to about seven VHS tapes. This clearly states my opinion on DVD.

Doug Palfreyman,
Quorrobolong, NSW.

DVD far superior to VHS

After reading the letters about DVD in the September and October issues, I felt compelled to provide my experiences in that direction. I have had a DVD player almost since they became available here. Having had three different units in that time, I can tell you that the quality of the picture does vary between the players. It is mostly in the set-up alternatives available but also in the design.

For example, the Toshiba allows selection of the 16:9 format for all DVDs that we have played whereas the new cheapie did not (that player has now been sold). To be sure, if the DVD is coded only in widescreen format, then there are scan lines at the top and bottom that are black - even in 16:9 mode. But there are about half as many as when (normal) 4:3 letterbox mode is selected.

Note that some DVDs do have dual coding which allows full vertical use of the screen but there seem to be less of these lately. The industry seems to want to put more "bonus material" on the DVD rather than provide alternative playback modes.

In all cases where we have compared the VHS and DVD versions of a movie, the DVD, even in letterbox mode, was far superior to two VHS machines. Our TV picture is two metres wide, from a video projector, using component video from the DVD and S-video from the VHS. Absolutely every defect in the TV picture is apparent in a picture that large. Our major source of complaint though is the wide variability of quality of picture from the free-to-air TV stations.

In particular, all stations have produced terrible outside broadcast pictures. The conversion used from digital to analog is also poor, with flicker and jerkiness in the rapidly changing parts of the picture. This same defect has also been noticed in normal definition digital mode from Digital TV.

We are now on our second projector, with each giving a slightly different picture, mostly due to the different type of projection. And while each had defects, such as a very slight shimmer in some parts of the picture on one, they both have given excellent results, with no line structure evident in either (due to line doubling).

On the sound side, there is no comparison between DVD and Hifi VHS. The 6 (or 5.1) channel digital bitstream from the DVD provides absolutely awesome sound, with the subwoofer capable of shaking you in your seat and the multi-channels enveloping you in the action. The 2-channel Dolby encoded Hifi VHS does not come close. I have a Sony sound system than can fully decode all systems. There is far more "atmosphere" with the digital sound.

My conclusion is that not all players or TVs are equal and that you need to have the right equipment, properly set up, to get the best out of DVDs. The same would apply to digital TV since there are many stories coming out on the Internet about problems there. The providers of DVDs also need to supply them with selectable alternative coding for full screen .

Bruce Withey,
via email.

DVD misconceptions

On reading the October, 2001 Mailbag I was struck by letters from two readers who seem to have gotten "less-than-optimal" results from their DVD viewing, so I thought that I would throw in my two cents worth.

In regard to Brad Sheargold's letter, first off, his friend has misquoted the resolution of his display to you. The most expensive Fujitsu model has approximately 1000 by 1000 pixels for a total area of one million pixels, not 1,000,000 by 1,000,000.

Secondly, you must realise that a plasma display has a lower contrast ratio and a smaller colour range than a normal TV which means that the picture will look washed-out and seem to miss detail in dark areas unless it is viewed under proper lighting conditions. Low indirect lighting is the definite go and the poor colour range and bad lighting would explain the "256 colours" impression you were getting.

All TVs need to be properly adjusted to get a really good image, plasma sets even more so. Do not rely on the factory default settings to be optimal, especially sharpness which should be turned right down for viewing DVDs, and brightness which needs to be adjusted carefully to ensure a good picture.

As for the image "continually digitally raining"; I own over 200 disks and have never encountered this effect playing a DVD but it could be a video connection problem.

Lastly, I have a 7-year old 68cm Sony TV that cost $1500 and a 2-year old $1000 Toshiba DVD player that together deliver wonderful picture quality, so I have to say that spending $US8000 - $US10,000 is definitely not required. Until I saw my first proper HDTV transmission just over two weeks ago, the quality of the picture that I have been watching has been unsurpassed.

I would urge Mr Sheargold to go into a hifi store and look at DVD running on a properly set up CRT-based TV before becoming too disillusioned.

In regard then to Mr John Richardson's letter, where do I start?

When a DVD is encoded for a full-frame 4:3 ratio image, the resolution of the image is approximately 720 by 540 pixels (approximately 500 TV lines). When a DVD is encoded for an anamorphic widescreen 16:9 ratio image, the resolution is 720 by 540 pixels. "How can they both be 720 x 540 when one is widescreen and the

other not?"

The answer is that DVD encodes the widescreen picture information in a full frame without any black bars, making the vertical resolution a full 500 lines, not 281 lines as Mr Richardson claims. When the image is displayed on the 4:3 format TV, the image is either "compressed" into the centre of the screen as my TV does, or re-interpolated by the DVD player to fit the screen and the black bars added. On a widescreen TV, the image is displayed in its full 500-line glory; a tad better than VHS' 220 lines.

As for FTA stations going to the trouble of encoding their transmissions between towers, it would seem to be very unlikely, especially since the black bars are left out of the encoding process. If they did however, you certainly would not be able to notice as analog TV is much lower resolution than MPEG2. Besides, if it's a conspiracy to save bandwidth, who are they saving it for? It's not like it hasn't already been allocated to them, and nobody is receiving a secret channel!

By the way, it is important to understand the quantitative as well as qualitative differences between MPEG encoding and MPEG2 encoding. MPEG compression, as can be seen in computer video and low-quality VCD movie disks that are popular in Asia, is about one quarter the resolution and a tenth of the bandwidth of a MPEG2 compressed movie on DVD.

Mr Richardson said that DVD has not delivered on its promises. I know of many disks that use multi-angle. Whether this is used for multiple camera angles or for some other purpose such as showing how a film is made is up to the director of the film. You can go out right now and find many disks with auto pan-and-scan encoding; I suggest "Galaxy Quest" or "Chicken Run" as examples.

I'll admit that while many disks will prevent you from jumping thought the copyright notices but you can easily skip around the disk once you're in. However, if you think that VHS-quality sound is just as good as DTS or Dolby Digital, I would say that you just haven't heard it yet or you need your ears checked.

When I first saw a DVD on a badly set up TV in a now-defunct electronics chain store, the quality was appalling. I almost gave up on the format then and there but since then I have seen and heard quality that far surpasses any other format.

Phil Harvey, Punchbowl, NSW.

Test equipment and parts on offer

I have been an electronic hobbyist since my teens and a professional electronics engineer since my mid-twenties. Now, I am getting beyond doing much "hobbying" and we are moving out of our house to a smaller unit.

I have a quantity of electronic components and test equipment (some commercial, some home-made). If anyone is interested in these items, I would be glad to send them a list, by email or mail, though email is better. I would only ask for a contribution to transport for many or large items, or where the recipient is far from Adelaide.

Ewart Jones, 15 Hurds Hill Drive,
Coromandel Valley, SA 5051. pejcoro@chariot.net.au

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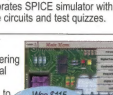
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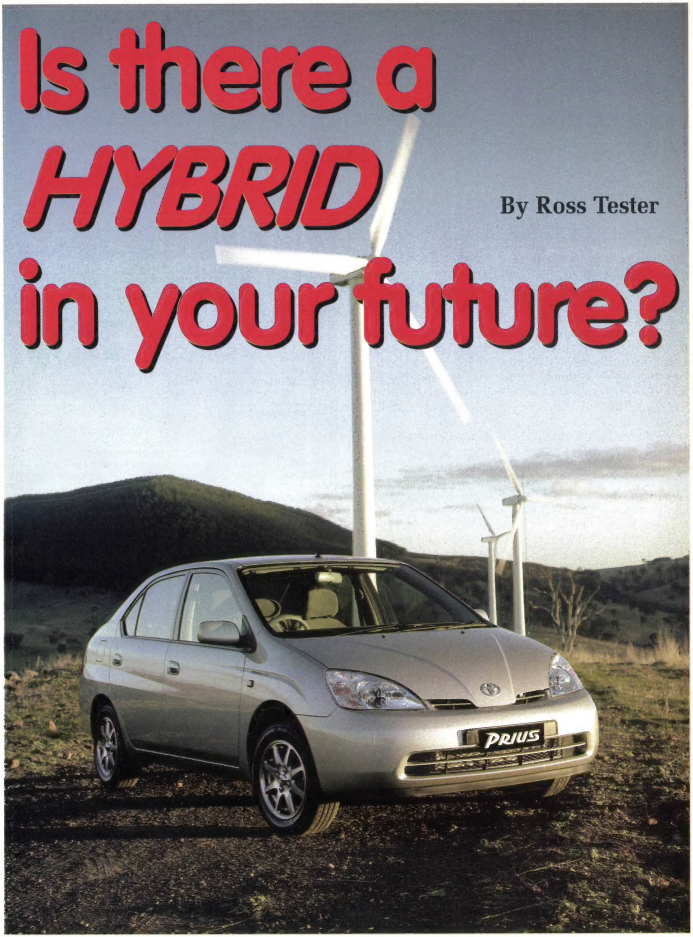
Is there a HYBRID in your future?

By Ross Tester



With petrol prices approaching a dollar per litre in many areas of Australia, motorists are starting to think "alternative". Immediately "electric" springs to mind but electric vehicles, especially cars, have yet to prove commercially viable. Now though, there is another alternative: the hybrid – a passenger car driven by both internal combustion (petrol) AND electric engines. Hybrids made quite a splash at October's Sydney International Motor Show.

There were two (or was it three?) hybrid vehicles on display at the Sydney Exhibition Centre. We went there specifically to look at the hybrids.

Toyota's Prius was launched with much fanfare. Honda had their Insight there – but being a year old, it wasn't given star treatment (in fact, it was almost undersold – I had to ask if it was actually there!). And since the show, I've discovered that there was a Toyota Tarago hybrid also on display – at least according to the Toyota PR people.

OK, so what exactly is a hybrid vehicle? To be more accurate with the answer, we should say there are two different types of hybrids – series and parallel. Both are based on the same theme: motive power is provided by both hydrocarbon fuel (usually petrol) and electric engines.

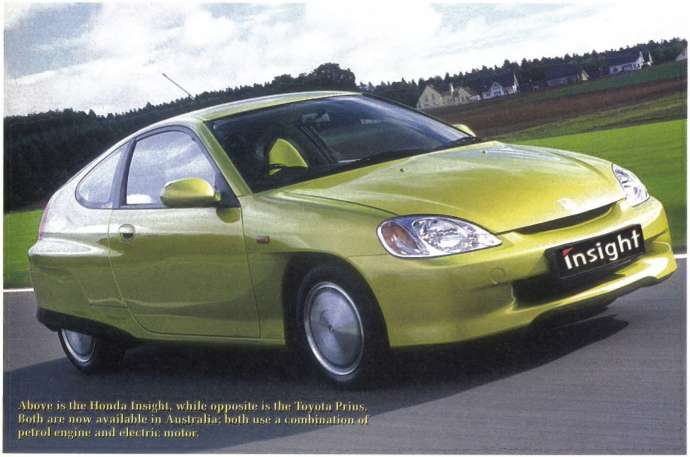
In a series hybrid, the whole of the fuel engine output is devoted to driving a generator, which in turn supplies the electric motor which turns the wheels. It's a similar arrangement to a diesel-electric locomotive. The main difference is that in most series hybrid vehicles, there is also some form of battery storage which can power the vehicle independently of the fuel engine – to some degree, anyway.

In a parallel hybrid, the fuel engine AND the electric motor can both drive the wheels. They share the load (pun intended!) according to the way the vehicle is being driven, ranging from 100% fuel engine and zero electric through to 100% electric and zero fuel. For a lot of the time, the proportions vary all over the place, under the management of one or several computers.

Why not all-electric?

As we mentioned before, while immense development has taken place around the world on 100% electric vehicles (ie, no fuel engine at all), there have been very few vehicles actually make it into production – and even fewer which have been commercial triumphs. In fact, the score to date hovers marginally above the zero mark!

Why is this? Quite simply, it is very difficult – if not impossible – to cram enough battery capacity into a vehicle to come even close to the energy avail-



Above is the Honda Insight, while opposite is the Toyota Prius. Both are now available in Australia; both use a combination of petrol engine and electric motor.

able from an equivalent volume, and especially weight, of hydrocarbon fuels – petrol, diesel, gas, etc.

Then there is the matter of energy replenishment. Electric vehicles need their discharged batteries recharged (or swapped over) at even shorter intervals than you would normally fill your petrol tank. Usually, this means charging overnight. It also means you cannot wander too far away from a charger or source of power.

While a jerry-can and funnel can get your petrol vehicle out of trouble out in the sticks within a few minutes, you'd need several hours and one mighty long extension cord for an electric vehicle!

Range is also a problem: 250-300km is often quoted as the best that the very best electric vehicles can achieve (and then only under ideal conditions); most petrol/diesel cars can achieve double or even triple this.

While huge advances have been made in batteries (and more recently fuel cells) they still simply cannot replace the easily-filled tank of fuel feeding an internal combustion engine. That's not to say it won't happen – somewhere down the track it (or another development) most certainly will. In fact, major manufacturers (including Toyota) are currently working on electric and fuel cell electric hybrid vehicles.

The Honda's engine looks much like other modern engines – until you get inside it! It's actually two engines in one.

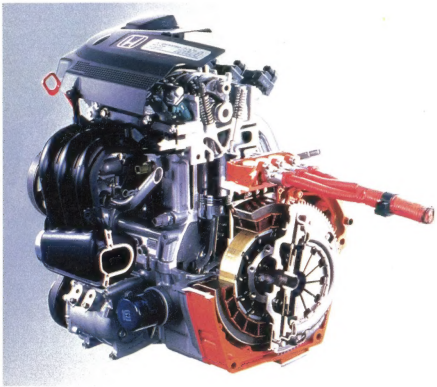
But don't hold your breath for something this year or even next. Toyota are talking "sometime in the next ten years . . ."

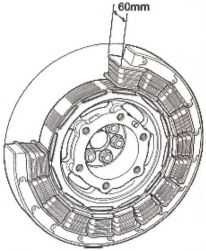
Back to the hybrids . . .

Honda and Toyota have taken quite different approaches to achieve quite similar results. We'll look at the Honda Insight first, mainly because it has been around for the best part of a year.

The Insight is based on the Honda Integrated Motor Assist (IMA) system. This combines a highly efficient one litre 3-cylinder lean-burn VTEC ULEV (ultra low emission vehicle) engine and ultrathin electric motor to produce 56kW of power. When we say "combines" we really mean it: an ultra-thin (60mm thick!) permanent-magnet electric motor is built into the engine, residing between the flywheel and the gearbox.

Electricity for the motor is stored in a 144V, 6.5Ah nickel-metal hydride battery pack controlled by an advanced electronic Power Control Unit (PCU). You read that correctly: the battery





At left is a cutaway of the Honda hybrid engine – the blue parts are the petrol driven while the red are the electric. Above is a drawing of the 60mm wide 10kW electric motor.

It's a very "conventional" looking dash and control layout, belieing the technology elsewhere in the car. The Honda has a 5-speed manual transmission.

pack is rated at only 6.5Ah and is in fact made up of 120 "D" cells!

Power for the system is primarily sourced from regenerative braking, eliminating the need for an external power source for recharging.

The battery pack, PCU and electronics package are hidden under a panel under the rear cargo area. The PCU ensures the battery can be neither overcharged nor overdischarged, resulting in much longer life than you'd normally expect from a NiMH unit.

Design features

There are many innovations in the Insight design, not the least of which is its aluminium body, weighing 40% less than a comparable steel car but having 13% greater rigidity. The vehicle also has a very low coefficient of drag – 0.25 – which means it cuts through the air with minimal friction. Even the side mirrors and the skirts around the rear wheels have been designed for minimal drag and wind turbulence.

The Insight features specially designed 165/65 R14 low-rolling resistance tyres, mounted on 14 X 5.5 JJ aluminium-alloy wheels, improving fuel efficiency by 6%. The tyres have 40% less rolling resistance and a 5% reduction in weight, compared with conventional tyres.

The power plant

Technologies such as lean-burn combustion, low-emission engines, variable valve timing, high-efficiency electric motors, regenerative braking, nickel-metal hydride battery technology and microproccessor control helped engineers develop an efficient, lightweight and compact hybrid drive system.

The Insight's primary power source is a 1-litre, 12-valve, 3-cylinder VTEC-E petrol engine. Although the engine alone provides sufficient driving performance – even in sustained uphill driving – a permanent-magnet electric motor mounted between the engine and transmission provides additional power assistance under certain conditions, such as initial acceleration from a stop.

The electric motor's role as power assistance allows it to be made smaller and lighter compared with the full-sized traction motors in other hybrid systems.

As the IMA petrol engine enters its mid-to-high-rpm operating range, the electric motor assist ceases and power is supplied solely by the engine, which is operating in its high-rpm 4-valve mode.

Power for the electric motor comes mainly by recapturing energy from the forward momentum and braking of the vehicle, rather than from the petrol engine. When the Insight is coasting or the brakes are applied while the vehicle is in gear, its electric-assist motor becomes a generator, converting forward momentum into electrical energy.

When a normal vehicle brakes, this energy is wasted as heat. But in the Insight, on light "braking" the brakes are not actually applied. Instead, regeneration slows the vehicle. Only on harder pressure do the brake pads actually contact the discs in the conventional way.

IMA electric motor assist

The ultra-thin 10kW DC brushless motor is highly efficient, light and compact.

The IMA electric motor is capable

The battery pack – consisting of 120 "D" cells – and the control unit hide under a panel roughly below the golf clubs. (The clubs are not standard equipment!).

of providing high torque at low speeds, and assists the one-litre engine during low-rpm acceleration for increased efficiency during normal driving.

The IMA's central rotor is manufactured using the "lost wax" casting method to give a precise shape and high strength for a 20 per cent weight reduction. For the rotor magnet, Honda enhanced the neodymium magnet originally used in the Honda EV Plus for an improvement in magnetic flux density or torque ratio by 8%. This also improved heat resistance, eradicating any need for a cooling system.

To create a thin motor, Honda used a simple structure including a split stator with compact salient-pole field winding and centralised bus ring, allowing a width of 60mm – 40% thinner than if conventional technologies were used.

The motor also doubles as a generator for the IMA system and a high-rpm starter, quickly spinning the engine to its ideal speed. If the IMA system battery charge is low or in the case of extreme temperatures, a separate (conventional) 12V battery and starter motor will start the engine.

The Honda Insight is not a cheap vehicle. At $52995 plus on-road costs it would take a lot of savings in petrol to make up the difference. And the recommended fuel for the Insight is the more expensive 95RON premium unleaded. Fuel economy, by the way, is 3.6l/100km city cycle and 2.8l/100km highway cycle – very good in anyone's language.

Toyota wanted to get in on the golf-bag act, too. . . but it does show just how roomy (and how "normal") the Prius is. The little vents you can see behind the rear doors are battery/controller excess heat vents.

Toyota Prius

Again and again, the staff at the Motor Show kept emphasising just how "normal" the Prius was. Normal to look at, normal to get into and out of, normal to drive, normal in "just about" every way.

And that's how Toyota have marketed their new five-seat "baby". Admittedly, they believe a significant proportion of their sales will be to new technology junkies and more than half will be sold to government and fleet buyers wanting to reduce running costs.

But the rest, they believe, will buy the Prius because it is *so* normal.

Like the Honda Insight, it has a very low drag coefficient (0.29) to help it slip through the air. Standard equipment includes dual SRS airbags, ABS brakes, front seatbelt pretensioners with force-limiters, power windows

Under the lid of the Toyota things do look a little different to a conventional car engine bay. The petrol power plant is on the left while one of the Prius' two electric motors can be seen on the right. Notice the heavy (red) power cables in the rear of the pic – they go off to the batteries and controller in the rear of the car.

and power mirrors, electric power steering and climate control air conditioning with an economy mode.

There is only one "option" available for the Prius: an integral satellite navigation system, based on DVDs. Everything else (and the list is extensive) is built in. Oh, one other option – it comes in various colours!

If it is so normal, what is different? Well, for a start, the Prius has not two engines but three.

Petrol engine

Main power is provided by an advanced 1.5-litre Atkinson Cycle, VVTi-equipped petrol engine which delivers 53kW of power at 4500rpm and 115Nm of torque at 4200rpm.

An Atkinson Cycle engine, by the way, has smaller combustion chambers and a higher compression ratio than a conventional (or "Otto cycle") engine. Compression ratio on the Prius powerplant is a whopping (for a petrol engine!) 13.5 – approaching that of diesel engines.

The Atkinson cycle was proposed in the 1880s by English engineer James Atkinson, to enable the compression stroke and expansion stroke to be mechanically set independently of each other.

The Atkinson cycle design makes better use of combustion energy by keeping the exhaust valves closed until the end of the expansion stroke. The expansion stroke is extended until the expansion pressure has virtually dissipated, converting more of the combustion energy into torque on the crankshaft.

Toyota has combined the Atkinson cycle with a long-stroke engine design, offset crankshaft, direct ignition and variable valve timing with intelligence (VVTi), to further improve efficiency.

The Hybrid System in Prius seamlessly combines the power of this engine and a 33kW electric motor.

In addition, the motor is part of the regenerative braking system. It converts the kinetic energy of the decelerating vehicle into electricity, for storage in the battery.

Permanent-magnet generator

The Toyota Hybrid System (THS) also has a high-efficiency AC permanent magnet synchronous generator, to run the electric motor and charge the battery. The generator also serves as a starter motor for the petrol engine.

In addition, the THS system uses the generator to control the ratio of power distribution from the power-split device.

Toyota have chosen a slightly different dash layout for the Prius. Of particular interest is the centre console, shown enlarged at right, which contains the engine management touch screen showing the status and operation of the fuel and electric sections. This doubles as the screen for the only Prius option: a DVD-based satellite navigation system. Below this is a totally integrated entertainment system (including CD stacker).

Inverter/Converter

Energy that is not required to propel the car is stored in a sealed 274V battery, for use when required.

The inverter turns direct current from the battery into alternating current for the drive motor, and the converter takes alternating current from the generator and motor (in regenerative braking mode) into direct current for storage in the battery.

Environmentally friendly

The Prius uses up to 50% less petrol than an equivalent-sized conventional car and emits about half the carbon dioxide on a typical city drive cycle. The petrol engine automatically switches off when the car is stationary and going downhill. When moving off, initial power is provided by the electric motor but the petrol engine also starts automatically with a virtually seamless transition.

Emissions of carbon monoxide, NOx and hydrocarbons are only one thirteenth of legislated maximum permissible levels and one fifth those of an equivalent sized conventional car.

Actual consumption figures for the Prius are 4.6 l/100km city cycle and 4.2l/100km highway cycle – obviously not as good as the Honda Insight but the car is a lot cheaper!

Continuously variable transmission

Prius' Toyota Hybrid System acts as an electronically controlled CVT, which can freely vary the engine speed. It achieves this by controlling the generator's revolutions. Therefore, the vehicle does not need a conventional transmission.

The power-split device operates via

a planetary gear system, in which the engine output shaft drives the planetary gear carrier and uses a set of pinion gears to simultaneously transmit power to the outer ring gear and the inner sun gear.

The shaft of the outer ring gear connects directly to the electric motor and (through the drive shaft) to the reduction gears and hence the front wheels. The shaft of the sun gear drives the generator.

The use of one set of planetary gears to achieve two roles provides a significant saving in weight and space under the bonnet, compared with either a traditional automatic transmission or a belt and pulley type CVT. There is no torque converter and hence no loss of energy through slippage in the driveline.

The Toyota Prius is significantly cheaper than the Honda Insight at $39,990 plus on-road costs. It is fully imported and numbers available for Australia are quite limited: we were told each dealer can have a maximum of one Prius per month.

Going for a drive . . .

We didn't get the opportunity to drive the Honda but we did drive the Toyota Prius, thanks to Bill Buckle Toyota who, as luck would have it, are just around the corner from the SILICON CHIP office.

It takes a few minutes to get used to the Prius because it behaves differently to other cars. That's not to say it behaves badly – far from it. It's just "different". One of the main differences is due to the continuously variable transmission. There is no change from one gear to the next.

Similarly, there is no push-in-the-seat acceleration, either. You plant your foot and you think it's taking off rather sedately – until you glance at the speedo and you're doing 80 in a 50 zone. Woops! Sorry, officer.

But the major difference is in noise or, to be more correct, lack of it. Sitting at a set of lights you think "it's stalled" which in truth it has – but deliberately so. Accelerate a little and you still hear virtually nothing. You are still hard-pressed to hear anything even when the petrol engine starts. You certainly don't feel anything except, perhaps, you are aware that you have more power available.

The main reason you know that the engine has cut in is that the LCD touch-screen on the dashboard tells you so. We'll look at little more closely at that LCD in a moment.

Another thing that the LCD tells you is that power is being taken from, or supplied to, the batteries. Driving along, you are completely unaware what is powering what unless you look at that screen.

Regenerative braking, where the electric motor becomes a generator and starts recharging the battery, occurs whenever you lift your foot off the accelerator or when you apply the brakes.

Braking is quite normal, except for one thing. Most of the time the brake pads make no contact with the discs! All of the braking effort (and you can feel it) is courtesy of regenerative braking. Only in an emergency stop, or when you apply very hard pressure to the brake pedal, will the mechanical brakes actually come into play.

If you're travelling down a long hill, you can move the gear lever to "B" and the engine forcibly brakes the vehicle all the way down, supplying electricity (and cutting off the fuel engine) as it does, without you touching the brake pedal.

Toyota maintain that brake pad wear will be a tiny fraction of a normal vehicle and tyre wear should also be way down. It is virtually impossible to "chuck a wheelie."

We mentioned before the touch-screen LCD panel. As well as giving a huge range of information about the vehicle and being the input device for a lot of user settings (eg, radio, air con, etc), it also doubles as the display for the optional $3800 satellite navigation system. I have to confess, techno junkie that I am, this was the thing that tickled my fancy most of all (forget the impressive range of technology I was driving . . .).

It tells you exactly where you are, where you are going, how to get there, even how to un-stuff a stuff-up (like when it tells you to turn left and you turn right instead!). It could even direct me right to my door (and those who know where my home is hidden will be mightily surprised at that!).

Just in case you couldn't tell, I'm impressed with the Prius. **SC**

Toyota Prius Vs Honda Insight Quick Comparison

	TOYOTA PRIUS	HONDA INSIGHT
Main Engine	In-line 4 cylinder DOHC 4V	In-line 3cyl SOHC VTEC
Capacity	1497cc	995cc
Maximum Power	53kW@4500rpm	56kw@5700rpm
Maximum Torque	115nm@4200rpm	113nm@1500rpm
Compression ratio	13.0:1	10.8:1
Fuel	91 RON (unleaded)	95RON (PULP)
Consumption - City cycle	4.6l/100km	3.6l/100km
Consumption - Highway cycle	4.2l/100km	2.8l/100km
Electric Motor(s)	2x high efficiency AC	Permanent Magnet
Output power	33kW	10kW
Battery	274V 6.5Ah NiMH	144V 6.5Ah NiMH
Transmission	Electronic Continuously Variable	5 speed manual
Steering	Electric Power Assisted	Electric Power Steering
Turning Circle	9.4m	10.2m
Vehicle Size	4315 x 1695 x 1485mm	3955 x 1695 x 1355mm
Weight	1250kg	827kg
Body	Steel	Aluminium
Regenerative Braking	Yes	Yes
Emissions	ULEV standard	ULEV standard
Auto engine shutoff on idle	Yes	Yes
Price	$39990 + ORC	$52990 + ORC
Warranty	3 years/100,000km	3 years/100,000km

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MICROSOFT'S new Windows XP operating system finally puts an end to the 16-bit DOS underpinnings of the Windows 95/98/Me product line. In its place is a stable new 32-bit operating system that's evolved from the Windows NT/Windows 2000 core but you'll need a fair bit of firepower to run it.

UNTIL NOW, you've really had two choices when it comes to a Microsoft operating system (OS) – Windows 98/Me or Windows NT/2000.

Home users have traditionally opted for Windows 98/Me due to its strong multimedia and games support, plus its support for a wide range of hardware and for features such as plug and play (P'nP), USB and Firewire. At least, that was the upside. The downside was that it was hardly the most stable OS around. Anyone who has used Windows 98/Me has, at one stage or another, encountered system lockups and the dreaded "blue screen of death".

It's no exaggeration to say that Windows 98/Me system crashes have caused PC users a lot of frustration.

That's why many businesses (and not a few home-users) have instead opted for the rock-solid stability of Windows NT or Windows 2000. These provided true multi-tasking ability without the frustrating lockups encountered in Windows 98/Me and are a must if you frequently multi-task or run heavy-duty applications such as desktop publishing or large accounting programs.

But Windows NT had its own drawbacks. It doesn't support USB or plug and play, has limited multimedia capabilities and has nowhere near the driver database of Windows 98/Me. It also cost considerably more than Windows 98/Me, was much more demanding in terms or hardware and was harder to setup – especially when it came to networking.

These problems were addressed to a large extent in Windows 2000 which added support for plug and play and USB. However, its hardware support, multimedia capabilities and games support were still inferior to Windows 98/Me.

HOW XP FITS IN

Windows XP supersedes both Windows 98/Me and Windows NT/2000, effectively unifying the two into one. This new "unified" OS boasts extensive multimedia capabilities, supports a wide range of hardware and is built on the rock-solid Windows NT/2000 operating core so it's a full 32-bit operating system. In a nutshell, Windows XP combines Windows 98/Me's multimedia and hardware support with Windows 2000's more stable and manageable kernel.

On top of that, Microsoft has done a lot of work on the interface. It's more intuitive to use than ever before, is far easier to set up than its predecessors and sports a stunning new look that you can tweak to your liking. Naturally, it has full support for plug and play, USB and Firewire and retains useful features such as Internet Connection Sharing (ICS) and the Net-

work Setup Wizard. There are also lots of new features and we'll look at some of those shortly.

You still have a choice when it comes to this new OS, though. That's because there are two versions – "Windows XP Home Edition" and "Windows XP Professional". Basically, the two are identical except that the Professional version includes extra networking and administration tools. It also includes multi-processor support, with support for up to two CPUs.

The version that you choose will depend on the OS that you're currently using and your personal requirements. You can upgrade Windows 98/Me to either XP Home or to XP Professional but note that you cannot upgrade from Windows 95.

If you're currently running Windows 98/Me and you don't have any special administrative requirements or require multi-processor support, then Windows XP Home Edition should do everything that you want. Alternatively, if you're a Windows NT/2000 user, you will need to go to XP Professional. There is no upgrade path from Windows NT/2000 to the XP Home Edition.

You can think of Home Edition as the logical upgrade for Windows 98/Me, while XP Professional is basically an upgrade for Windows 2000.

SYSTEM REQUIREMENTS

You'll need some pretty decent hardware to run Windows XP, so don't expect to be able to whack it on anything that's more than a few years old – not if you want acceptable performance that is. At the very minimum Microsoft recommends a 233MHz Pentium II machine with 64Mb of RAM, a CD ROM drive and 1.5Gb of free hard disk space.

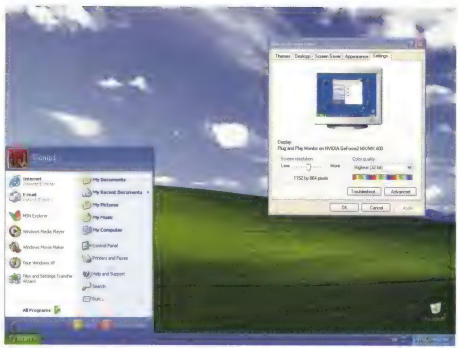

Fig.1: Windows XP features a radically altered Taskbar and a "Start" menu that lists your most recently used applications. The default desktop (shown here) is called "Bliss" and a fresh install places just one icon on the desktop – the Recycle Bin. You can easily add the familiar icons shown at right by clicking the "Customize Desktop" button in the Display Properties dialog box.

Now while Windows XP will run on this minimal system ("crawl" might be a better word), you'll really want something better – particularly when it comes to RAM. Windows XP likes lots of RAM and a 400MHz Pentium II with 128Mb of RAM will be a much better proposition.

In fact, with RAM prices at an all-time low, there's no excuse for not going to 256Mb of RAM or more. The performance gains with Windows XP will be well worthwhile, particularly if you intend running lots of applications at once or switching between users. You can now pick up 256Mb of PC133 SDRAM for just $70, so there's no reason to hold back.

For multimedia enthusiasts, a 1GHz Pentium III or Athlon-equivalent PC with 256Mb of RAM, a DVD-ROM drive, a CD-RW drive, a sound card and a video card with 32MB of RAM will be necessary to extract the full benefits of Windows XP. Fortunately, PC hardware has moved a long way in the last few years, so performance with Windows XP will not be an issue if you are buying a new machine.

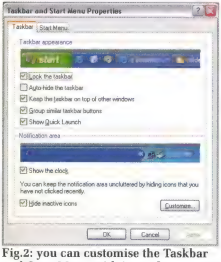

Fig.2: you can customise the Taskbar and Start Menu with just a few mouse clicks.

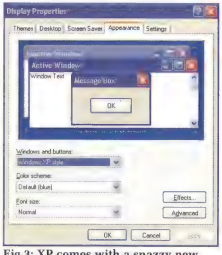

Fig.3: XP comes with a snazzy new look and there are several new colour schemes to choose from.

INSTALLING WINDOWS XP

Barring any hardware incompatibility issues, installing Windows XP is a straightforward procedure. You can check whether your existing hardware is compatible by going to Microsoft's hardware compatibility list located at **www.microsoft.com/hcl/default.asp** before actually buying Windows XP.

If you already have Windows XP,

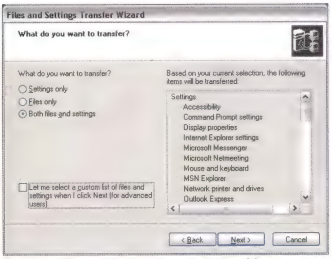

Fig.4: the Files and Settings Transfer Wizard lets you easily transfer your Internet, email & dial-up settings and/or data files between computers or individual disk drives.

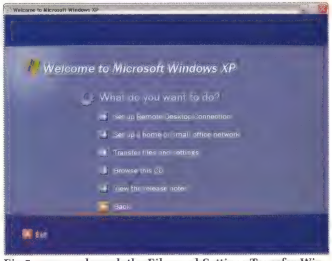

Fig.5: you can launch the Files and Settings Transfer Wizard from the Windows XP setup CD or access it via the Start button after Windows XP is installed.

it's a good idea to run the compatibility checking program that's on the installation disk. This will also reveal any software incompatibility problems if you are upgrading an existing system. Anti-virus programs, CD-ROM burning programs and system utilities are the most likely to cause problems here and these should be uninstalled if problems are found. If you have an Internet connection, the compatibility program will also offer to download any updated setup files and drivers before installation starts.

There are several approaches you can take when installing Windows XP:

- Upgrade "over the top" of your existing OS. This will keep your existing files and system settings (eg, for network and Internet connections);
- Install a new copy of Windows XP into the same disk partition as the existing OS. This will delete all programs and system files from a previous installation);
- Install a new copy of Windows XP onto a different partition or disk drive to the existing OS. This results in a dual-boot system that lets you choose between your previous OS and Windows XP each time you boot the computer (ie, a boot menu appears); or
- Back up all your data and system file settings, repartition and reformat the disk drive, and do a "clean" install of Windows XP.

If you choose any of the last three options, the XP installer brings up a partition screen. This lets you create new partitions in any unpartitioned disk space, delete existing partitions and select the target partition. You cannot resize or merge partitions using the Windows XP partitioning utility, though. If you want to do that, you will have to use a third-party partitioning utility such as Partition Magic before installing Windows XP.

Assuming that you're simply upgrading an existing system, you can start the upgrade procedure simply by booting the PC and inserting the Windows XP CD into the CD-ROM drive. Provided "Autorun" is enabled, the CD-ROM drive will automatically start and bring up the installation menu. After that, it really is just a matter of following the bouncing ball – not that you need to do much.

One thing that Windows 98/Me users will need to consider is whether to convert the disk to NTFS (NT File System) format or stick with the FAT32 (File Allocation Table) format. In most cases, you'll want to go with NTFS – it's faster, more reliable and offers bet-

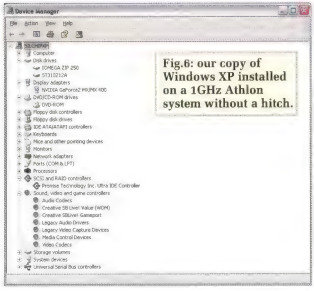

Fig.6: our copy of Windows XP installed on a 1GHz Athlon system without a hitch.

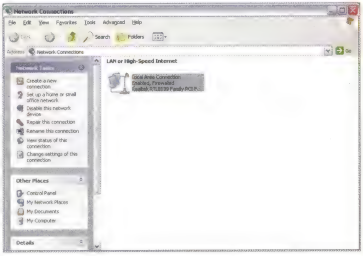

Fig.7: setting up local area network (LAN) and Internet connections has never been easier.

Fig.8: Windows XP is strong on multimedia. The new Windows Media Player 8 plays audio and DVD files, tunes to radio stations and makes it easy to copy files to a CD.

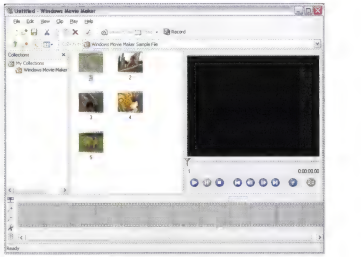

Fig.9: Windows Movie Maker is still fairly limited and allows only basic video editing tasks to be performed. Most users will find it adequate.

ter security than FAT32. Stick with FAT32 if you are installing a dual-boot system though, as Win98/Me cannot recognise NTFS partitions.

If you do go ahead and install to a FAT32 partition, you can always convert it to NTFS format (without losing data) after Windows XP has been installed. It's a one-way street though – once you've converted to NTFS, there's no going back to FAT32 without repartitioning the disk.

CLEAN INSTALL

Personally, I always use a new OS as an excuse to repartition and reformat the hard disk. That way, you start with a completely fresh installation without any of the unwanted debris from a previous setup. It also gets rid of any stuff that's just clogging up the hard disk.

In this case, you boot the machine directly from the setup CD (note: you may have to alter the boot order in your system BIOS to do this). This initially takes you to a text-based setup menu which allows you to partition and format the hard disk as required. Setup then copies some system files to the hard disk, after which the machine automatically reboots and begins installing Windows XP.

During installation, the upgrade version searches for evidence of the previous OS, to confirm that you qualify for the upgrade. However, if you're starting with a "blank" hard disk, all traces of the previous operating system will be gone. The trick is to "show" the system the setup disk from your previous version of Windows when asked to do so (even an upgrade disk for the previous OS will do).

By the way, both the upgrade and the full retail versions of Windows XP install exactly the same files onto the hard disk drive. The only difference between them is that the full version doesn't do compliance checking.

You can also boot directly from the CD if you intend installing Windows XP to a new partition, as part of a dual-boot system. However, it's not possible to upgrade over the top of an existing system if booting direct from the CD.

HOW GOOD IS THE INSTALLER?

In a word, it's slick. The installation takes about 1 hour and 20 minutes on a reasonably fast machine and most of it happens automatically. And provided you have all the settings at your fingertips, you can step through the Network and Internet Connection Sharing Wizards (if required) during setup. Alternatively, you can use these wizards to set up your network and Internet connections at any time after XP has been installed.

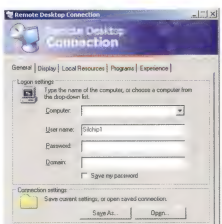

Fig.10: Remote Desktop is found only in XP Professional. It allows you to control the XP desktop from another PC so that you can access data and applications from a remote location.

With Windows XP, you no longer have to be a guru to set up a network.

In our case, we installed Windows XP on a 1GHz Athlon machine and it all went without a hiccup. To our delight, the installer correctly identified all the machine's hardware and installed the correct drivers – including drivers for the DVD-ROM & ZIP drives, the GeForce2 MX video card, the network card, the Creative SB Live! sound card and even the Promise Technology Ultra-IDE controller (Fig.6).

We didn't have to do a thing in that department – you really can't do better than that. What's more, we found that we had immediate connectivity to our network and to the Internet.

THE NEW INTERFACE

The Windows XP interface has a less cluttered look than ever before, with only the Recycle Bin appearing on the default desktop. The Start button and Taskbar look different too, the familiar grey look replaced by a colourful green and blue colour scheme.

Fig.1 shows the appearance of the default desktop. In case your wondering, the rolling green hills and blue sky combination is called "Bliss". Yeeeeeeeshh! Fortunately, there are lots of other desktop themes to choose

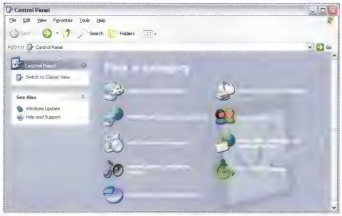

Fig.11: the Control Panel has been given a make-over, with the opening dialog listing nine categories in place of the familiar icons. The icons are just a click away, though.

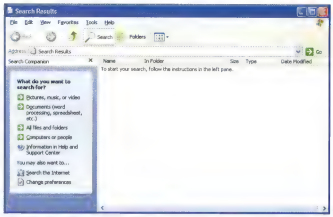

Fig.12: the "Search" utility is much improved in Windows XP, with lots of options to choose from in the task pane on the left.

from or better still, you can get rid of the desktop theme altogether. There are also some new colour schemes to choose from – "Silver" looks good in our opinion.

The windows also have an elegant new look, with rounded top corners and colourful new icons and buttons. In short, we really liked the new XP "style" but you can easily revert to the Windows "classic" style if that's what you prefer (just right-click the desktop, click Properties and click the Appearance tab).

Click the "Start" button and you'll soon discover that Microsoft has put some thought into this as well. The new "fly-up" menu now has two vertical columns, the lefthand side listing your most recently used programs and the righthand side giving you fast access to the main documents folders, Control Panel, Search and so on - see Fig.1.

By default, the Taskbar is locked into place (you can unlock it if you like) and you can hide "inactive" icons in the System Tray (or notification area). Clicking a little button arrow "slides" them out for access and they then automatically slide back in again when you're done (Fig.3).

Again you can take the Taskbar back to the Windows classic look. If you do, some additional icons "magically" appear on the desktop – My Documents, My Computer, My Network Places & Internet Explorer. These are not normally shown on the desktop if you use the XP "look", since you have fast access to them via the Start button, but you can easily add them if you wish.

PUMPING UP EXPLORER

At long last, Microsoft has done something about the rather anaemic Windows Explorer that's despised by just about everyone. Now, when you open up certain folders, so-called "Task Panes" appear on the left, as shown in Fig.14. These Task Panes relate to the contents of the folder (ie, the file types) and make it easy to carry out a variety of operations or to jump to other locations.

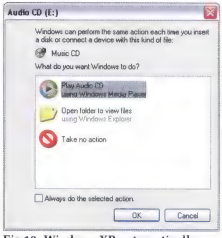

Fig.13: Windows XP automatically opens an "actions" dialog box each time you insert removable media or connect a digital media device. The options vary according to the media type (eg, audio or pictures).

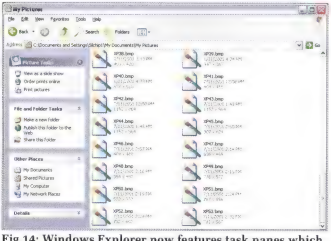

Fig.14: Windows Explorer now features task panes which make it easy to carry out a variety of operations. The task pane options change depending on the folder contents.

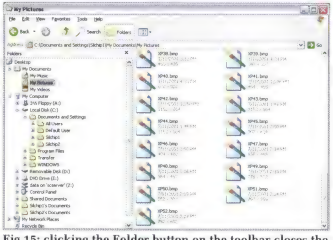

Fig.15: clicking the Folder button on the toolbar closes the task panes and restores the familiar "tree-like" view of folders and disk drives.

For example, if you open a folder of picture files, the Task Panes let you quickly print a selected picture, view a series of selected pictures as a slide show, email the selected files or carry out a range of other tasks.

If you want to see the familiar folders "tree" instead, you just click the "Folders" icon on the Toolbar. Clicking this icon again takes you back to the Task Panes view.

The Search utility is much improved as well and the Control Panel also gets a worthwhile make-over, with the initial display of icons now replaced by nine categories – see Fig.11. Clicking "Switch to Classic View" gives you back the familiar icons if you prefer the old layout.

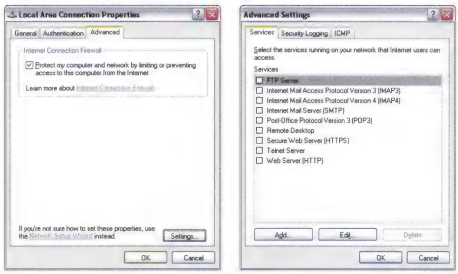

Fig.16: Windows XP includes Internet Connection Firewall (ICF). This blocks ports that can be accessed via the Internet but you can unblock selected ports to provide access to various services (eg, to an FTP server or an HTTP server).

MULTIMEDIA SUPPORT

This is where Windows XP really shines, with much of the improvement due to the new Windows Media Player 8.0 (WMP). This versatile tool creates audio CDs, plays streaming audio and video files, tunes into Internet radio stations and can even play DVDs – provided you install either a hardware or software DVD decoder, that is.

Copying CD tracks (in WMA format) to the hard disk is a cinch and WMP 8 includes a basic CD burner so that you can make your own music CDs. It's not quite as comprehensive as dedicated CD burner software but it's all most users will ever need.

You can burn audio CDs in both WMA and MP3 format, as well as data CDs, but note that WMP 8 cannot rip audio files to MP3 format unless you purchase a third-party plug-in. You don't really have to lay out extra cash though – there are plenty of "freebie" MP3 encoders available on-line, such as MusicMatch Jukebox and CDex.

Provided they're on-line and you're connected to the Internet, WMP automatically downloads track titles if you insert an audio CD (see Fig.8). Alternatively, you can add artist and track titles manually using standard ID3 tags before creating playlists.

In case you're wondering, you cannot use WMP 8 with earlier versions of Windows. It's tightly tied to the new XP interface, so you're stuck with WMP 7 if you stay with Windows 98/Me or Windows 2000.

Also on the multimedia front, Windows XP includes Movie Maker. It works OK but still allows only basic editing tasks to be performed.

LET'S CHANGE USERS

Windows XP makes it easy to set up separate User Accounts and allows you to "fast switch" between them without shutting down applications. This is a great feature if you have more than one person using the computer.

Among other things, User Accounts also allow you to:

- customise the way Windows and the desktop look for each user;
- have your own lists of web Favourites and recently visited sites;

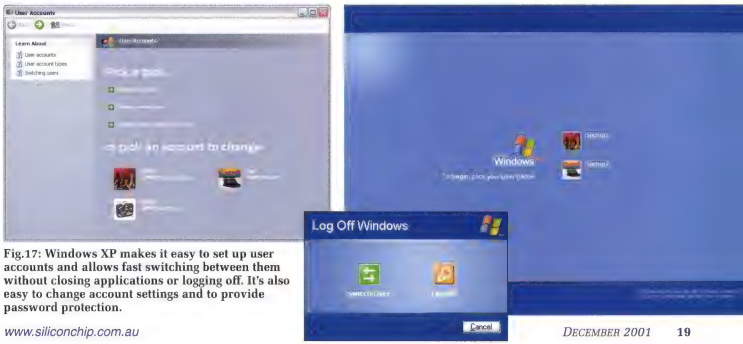

Fig.17: Windows XP makes it easy to set up user accounts and allows fast switching between them without closing applications or logging off. It's also easy to change account settings and to provide password protection.

Windows Product Activation: Don't Sweat It

To combat software piracy, Microsoft has introduced what is arguably Windows XP's most contentious feature – Windows Product Activation (WPA). When you install Windows XP, you must activate it – either via the Internet or manually via the phone – within 30 days, otherwise the OS will stop working until you do.

Activation involves obtaining a key which is derived from up to 10 hardware components in your PC. When you install Windows XP, it checks the amount of memory and also derives unique serial numbers from devices such as your network card, video card, hard disk and CD-ROM drives, the motherboard and the processor. This information is then used to derive a unique 25-character key which is combined with the 25-character "Product Key" supplied with the Windows XP installation CD to produce the "Installation ID".

In effect, WPA locks each copy of Windows XP to the hardware of a particular PC. This ensures that you can use your copy of Windows XP on one computer only and prevents you from sharing it with friends or colleagues in the workplace, or from borrowing someone else's copy. It also prevents illegal hard disk cloning, whereby an entire image is copied from the hard disk of one PC onto the hard disk of another.

Now unless anyone thinks that this is an impost and a horror to LOLs (little old ladies), it's really no big deal. For starters, Windows Product Activation is fast, no files are scanned and no personal information or serial numbers are sent to Microsoft, so there are no worries on that score.

You also have plenty of leeway when it comes to upgrading. For example, if your PC has a network adapter, you can change up to five other hardware items in one go (or eight in a laptop computer) without having to reactivate. Alternatively, you can change the network adapter plus three other components (seven on a laptop) without problems.

Adding additional components, such as a second hard disk drive or CD-RW drive, has no effect on WPA. And changing the same item several times only counts as a single change, so if you want to compare 20 different video cards, you can do so to your heart's content without triggering WPA.

Of course, if you reformat your hard disk and reinstall Windows XP, you will have to "re-activate". That's because the WPA information is stored on the hard disk drive and is destroyed if the drive is reformatted. However, provided the hardware isn't changed substantially, you can do this as many times as you like.

As a final refinement, WPA automatically resets itself every three months so that you can start the upgrade procedure over again. In addition, Microsoft state that WPA will automatically allow reactivation over the Internet up to four times in one year an substantially different hardware. This is so that "power users" can keep up with the very latest technology and regularly make substantial hardware upgrades to their systems.

Users who buy a new PC with Windows XP preloaded will probably never have to deal with WPA – unless the hard disk is reformatted. What's more, PC makers can lock OEM copies of Windows XP to the PC's BIOS, so that users can later swap everything, including the hard disk (but not the motherboard) without re-activating.

Finally, businesses that need to install Windows XP on multiple computers don't have to go through the WPA. Instead, they can obtain a special "volume licence product key" which allows a single hard disk to be cloned across multiple machines, without the need for activation.

- have your own My Documents folder and use a password to keep files private and protected; and
- protect important personal computer settings.

There are two different types of User Accounts: "Computer Administrator" and "Limited". A user with a Limited account has restricted file access and cannot install programs, make system changes or alter other accounts.

You can either set up your User Accounts when you install XP or add them later via the Control Panel. The Control Panel also allows you to change User Account names, set up and change passwords, and add or delete User Accounts.

If you set up User Accounts, a welcome screen appears each time you load Windows and you can then log onto your personal account. Individual User Accounts can be password protected to keep other users out but if there is no password, it's just a matter of clicking the account icon.

The Fast User Switching feature allows you to leave applications running while you switch to another account; eg, if another family member wishes to print something out. When you then switch back to your account, your applications will still be running just as you left them.

KEEPING OUT THE BAD GUYS

Keeping Internet nasties away is important these days and Microsoft has finally included some basic firewall protection into Windows XP. It's called Internet Connection Firewall and it's basically a port blocking firewall that can easily be configured to allow certain services; eg, FTP, HTTP & ICMP (echo) requests, etc (see Fig.6).

Blocking incoming ports greatly reduces the chances of being hacked, so ICF should be enabled on any computer that's directly connected to the Internet. Similarly, if your network uses Internet Connection Sharing (ICS) to provide Internet access for multiple computers, ICF should be enabled on the shared Internet connection.

For home users, ICF is probably good enough but a dedicated third-party firewall designed to work with Windows XP should be installed if security is important. You can easily disable ICF is you decide to use a dedicated firewall package.

KEEPING XP HEALTHY

Ever installed a hardware driver that caused system instability? With Windows XP, you can easily revert to the previously installed driver using the new "Device Driver Rollback" feature

that's found in Device Manager (see Fig.19). In addition, Windows XP includes "System Restore" which enables you to roll your system back to an earlier "restore point" and undo any harmful changes.

As expected, Windows Update has been included which allows Windows XP to look for new updates on the Internet. And like Windows 2000, XP includes Windows File Protection. This prevents the replacement of protected system files such as .sys, .dll, .ocx, .ttf, .fon, and .exe files unless the correct digital signature is found. It runs in the background and protects all files installed by the Windows Setup program.

Another useful feature is the Program Compatibility Wizard. This allows you to emulate older Windows OS'es in order to get incompatible programs to work. Once the program is working, you can then save the settings so that it runs properly each time it is used. Of course, it's better to store an update for the program if it's available, so that you don't have to use the compatibility wizard.

OTHER GOODIES

By now, you should be getting the idea that Windows XP has a very extensive list of features – far too numerous to cover in detail, in fact. There are lots of features that we haven't even mentioned, including MSN Messenger (an instant messaging program that works over the Internet), improved support for wireless networking, a "File and Settings Transfer Wizard" and Remote Assistance. Briefly, the "File and Settings Transfer Wizard" makes it easy to transfer your system settings (eg, Internet, email & dial-up settings) and/or data files between computers or disk drives when you install Windows XP. You can access it via the Start button, via the menus on the Windows XP installation disk or create a "Files & Settings Transfer Wizard" utility disk (eg, on a floppy disk or ZIP disk drive).

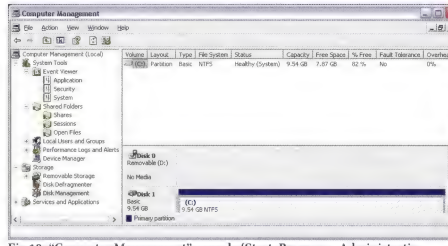

Fig.18: "Computer Management" console (Start, Programs, Administrative Tools) gives you fast access to a range of administrative utilities.

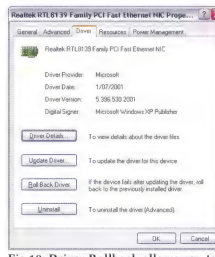

Fig.19: Driver Rollback allows you to restore the previously installed driver if a new driver causes problems.

The Remote Assistance feature is a useful troubleshooting aid if you get into difficulties. It allows a friend (presumably someone who is computer savvy) or a computer dealer who is also running Windows XP to connect to your computer via the Internet, chat with you online, view your desktop and to work on your computer.

THE BOTTOM LINE

We have to admit that we liked Windows XP. Admittedly, there's not an awful lot of incentive to upgrade if you're currently using Windows 2000 (unless there's a feature you must have) but Windows 98/Me/NT users should take a closer look.

If it's stability that you're after and you're currently using Windows 98/Me, Windows XP is a very attractive upgrade – just be sure that you have the firepower to run it. **SC**

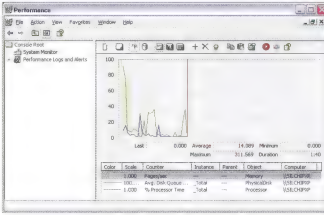

Fig.20: you can monitor the performance of various system parameters and examine performance logs and alerts.

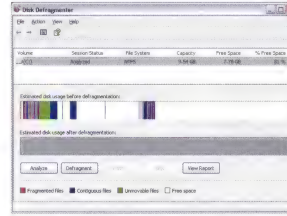

Fig.21: want to defragment your hard disk drive? Like Windows 2000, Windows XP includes its own disk defragger.

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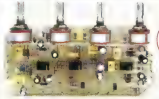

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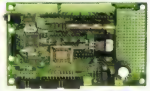

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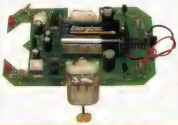

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PC Infrared Transceiver

. . . build it for peanuts

Did you know that most PCs these days include infrared (IR) support out of the box? Build this super-simple transceiver and add IR capability to your PC for peanuts.

by Peter Smith

JUST ABOUT EVERY Pentium-class PC motherboard supports infrared communications. Even so, you won't find a little red window anywhere on your desktop machine. For reasons unknown, this "luxury" has generally only been included on laptops, PDAs and the like.

With just one IC and a couple of resistors and capacitors, this tiny project remedies the situation and enables your desktop PC to communicate with these and a multitude of other infrared-capable devices (see below).

No wires, no hassles

Infrared communications between devices has one big benefit – it doesn't require a physical connection. This means no problems with connector compatibility or lost cables, and there's no need to crawl around behind your desk looking for the right socket!

Data is exchanged between devices using infrared light pulses rather than electrical pulses. Of course, devices need to communicate at the same speed, using the same protocol. Just how is this achieved?

IrDA infrared

In 1993, a large group of industry leaders got together and formed the Infrared Data Association (IrDA). The IrDA group came up with a set of standards that are now employed on over 300 million electronic devices. These include desktop, notebook and palm PCs, printers, digital cameras, public phones/kiosks, cellular phones, pagers, PDAs, electronic books, electronic wallets, toys, watches and other mobile devices.

In simple terms, the IrDA group defined a system of point-to-point data transfer operating over a 30° cone at a distance of up to one metre (typically two metres).

So how fast is it? Well, the endless quest for faster data transfer has seen dramatic increases over the preceding eight years, with four "milestone" rates now defined. These are SIR (serial IR, 115.2kbps), MIR (medium speed IR, 1.152Mbps), FIR (fast speed IR, 4Mbps) and VFIR (very fast speed IR, 16Mbps).

While we're aware of some (recent) motherboards that support FIR, we've stuck with SIR for this project as it

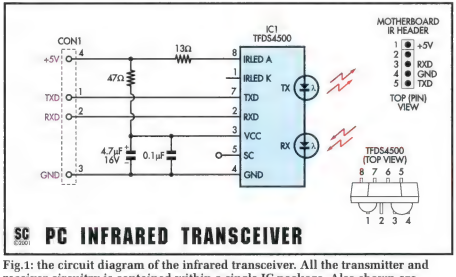


Fig.1: the circuit diagram of the infrared transceiver. All the transmitter and receiver circuitry is contained within a single IC package. Also shown are typical pinouts for the IR header provided on most PC motherboards.

is supported on all Pentium-class motherboards that we've seen.

Infrared on desktops

If you've ever poked around in your motherboard BIOS settings, you might have noticed that the second serial port can be set up as either a "standard" port or an "IR" port. In "IR" mode, data transmitted from the serial port hardware is directed to pulse shaping circuitry rather than to the usual 9-pin external serial connector. This circuitry reduces the pulse widths to 3/16th of their original length in order to reduce power dissipation in the IR LED and associated components.

On the input side, the opposite occurs. Pulses from the IR receiver are stretched back to their original widths and steered to the serial port receive circuitry.

The transmit and receive signals from the pulse shaping circuitry are usually terminated on a 5-pin header on PC motherboards (see Fig.1). To complete the IR subsystem, all that's needed is an IR detector and amplifier (the receiver), along with an IR LED and driver (the transmitter). No doubt you've guessed that this is where our little project fits in!

Circuit description

The circuit diagram in Fig.1 reveals what is possibly our simplest construction project yet! The IR driver and receiver elements are both contained within a single package – a TFDS4500 Serial Infrared Transceiver Module from Vishay Telefunken. Fig.2 shows the basics of what's hidden inside this little beauty.

A 47Ω resistor and two capacitors form a simple supply line filter, ensuring that noise from the LED driver doesn't interfere with the sensitive receiver circuitry. The only other component, a 13Ω resistor, sets the current through the IR emitter. According to the data sheets, this results in about 210mA of LED current for an intensity of about 180mW/sr.

Receiver sensitivity can be increased by connecting the SC (sensitivity control) pin to a logic high (+5V). If left disconnected (as in our circuit), it automatically assumes a logic low (near 0V). This is the default and most reliable mode. On the PC board pattern, you'll notice that we've connected a spare (unused) pad to this pin. If you'd like to experiment with the higher sensitivity mode, simply wire the pad to the positive side of one of the capacitors.

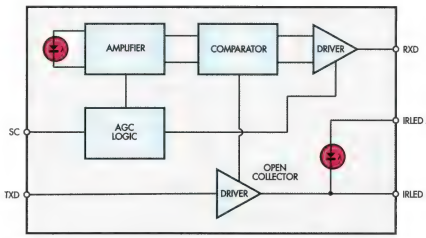


Fig.2: basic functional blocks of the TFDS4500 transceiver module. Unlike some infrared control systems, data is not transmitted on a carrier. Instead, it is pulse-width modulated and then applied to the TXD pin for direct transmission.

The IR transceiver cable plugs into a matching header on the motherboard.

Construction

Using the overlay diagrams in Fig.3 as a guide, begin by installing the transceiver module (IC1) on the bottom (copper) side of the board. This is a surface mount device, so you'll need a fine-tipped soldering iron and light gauge solder for the job. The leads of this device must all sit perfectly "flat" on the board surface and in line with the copper pads. We had to carefully adjust ours with fine-tipped pliers (you could also use tweezers) to get the alignment right. It's a good idea to inspect your work with a magnifying

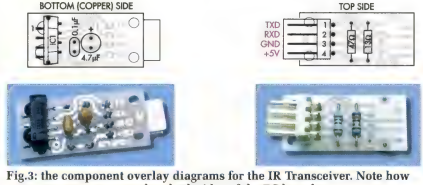
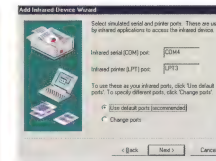


Fig.3: the component overlay diagrams for the IR Transceiver. Note how components are mounted on both sides of the PC board.

Fig.4: a short length of rainbow cable and two header sockets are all that's needed for the hook-up cable.



Figs.5-9: follow this series of screen shots to manually add your new infrared device in Windows Me. If it's not auto-detected in Windows 98, you can follow the same steps.

glass, as fine solder bridges are hard to spot with the naked eye.

Still on the bottom (copper) side, install the two capacitors, noting that the 4.7µF tantalum capacitor is polarised and must be oriented as shown. Now flip the board over and cut off the protruding capacitor leads flush with the surface of the PC board.

The two resistors and CON1 mount on the top side of the board. Install the resistors first, spacing them just slightly above the board surface to be sure that the sharp ends of the capacitor leads do not pierce the resistors' insulation. A piece of thin cardboard makes a good temporary spacer. Finally, install CON1, making sure that it is seated squarely before soldering.

Right, on to the cable. We used a one-metre length of rainbow cable for the job, stripping a 4-way section from a wider (10-way) piece. Fit a 4-way header socket on the transceiver end of the cable and a five-way header on the motherboard end, using Fig.4 as a guide. If you can't get a 5-way header socket, then you can make one by cutting down a longer section with a sharp utility knife.

You should refer to your motherboard manual when wiring the 5-way header, as although the wiring we have shown is common to most motherboards, we know of some that use different header pinouts. There are even a few that use something other than 5-way in-line header pins to terminate the IR signals, so you'll need to improvise if you have one of these.

Transceiver housing

We've left the housing arrangements of the transceiver up to you. If you don't want to build it into anything, then some insulation tape or heat-shrink tubing around the conductive parts is essential. Why? Well, the metal casing of your PC is at logic ground (0V), so accidental contact with the transceiver circuitry might damage your motherboard.

Hooking it up

Again, refer to your motherboard manual to locate the IR header and make a note of which end of the row of pins is marked as pin 1. Plug in your cable with pin 1 on the socket aligned with pin 1 on the header and route it out of the case via any convenient location at the rear. Don't plug in the transceiver just yet, though.

Power up your PC and using a multimeter, measure between pins 3 (GND) and 4 (+5V) on the transceiver socket.

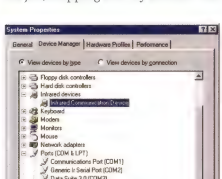


Fig.10: to check that the IR device has been installed, double-click on the System icon in Control Panel to view System Properties. This is what the settings on the Device Manager tab look like for a Windows 95 system.

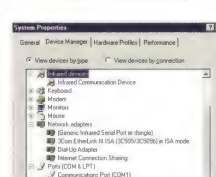


Fig.11: Device Manager settings for a Windows Me system. Windows 98 looks similar, although the IR device will probably be listed as an "Infrared PnP Serial Port" rather than the "Generic" one shown here.

Fig.12: Windows 95 & 98 display an icon in the system tray when infrared communications are enabled. Later versions of Windows only display the icon when another active infrared device comes within range.

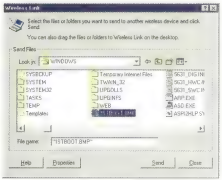


Fig.13: Wireless Link is an easy way to transfer files between computers, but it's only available on Windows Me and later.

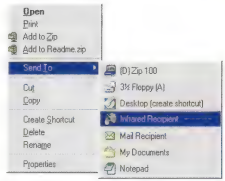


Fig.14: Windows 95 and 98 users can use the Send To menu in Explorer to transfer files to a nearby computer.

Fig.15: the full-size etching pattern for the PC board.

Parts List

1 PC board, code 07112011, 30.2mm x 14.2mm
1 90° PC-mount 4-pin header (CON1)
1 4-pin header socket to suit above
1 5-pin header socket for motherboard connection (see text)
1m 4-way rainbow cable

Semiconductors
1 TFDS4500 Serial Infrared Transceiver Module (Vishay Telefunken)

Capacitors
1 4.7µF 16VW tantalum
1 0.1µF 50V monolithic ceramic

Resistors (0.25W, 1%)
1 47Ω
1 13Ω

Your meter should read +5V ± 0.25V. If all is well, power down and plug in the transceiver.

Software setup

The first step is to enable IR support in your system BIOS. Refer to your motherboard manual for details on how to do this. Generally, the relevant settings reside under the "Integrated Peripherals" section, and involve changing the second serial port from "serial" to "IR" or "SIR" mode.

Windows 95, 98, Me, 2000 and XP (but not NT) all provide IrDA support. Unfortunately, the installation steps and levels of support vary considerably between versions, so we're only able to cover the highlights here.

If you have Windows 95, you'll first need to download the IrDA 2.0 Infrared Driver from: **www.microsoft.com/windows95/downloads**.

You'll need to save the downloaded file (W95IR.EXE) in a temporary directory and double-click on it to extract the contents. Installation instructions and troubleshooting tips are contained in the RELNOTES.DOC file.

For Windows 98, the infrared device (called an "Infrared PnP Serial Port") should be automatically detected at startup after you enable IR support in the BIOS. If not, then add a "Generic Infrared Serial Port or dongle" using the **Add New Hardware** wizard, accessible via Control Panel. The steps to do this are almost identical to those for Windows Me, as shown in Figs.5-9.

For Windows Me, you need to run a file on your Windows Me installation CD before manually installing the infrared device. The file to look for is named IRDASIR.REG and can be found in the \TOOLS\PSSUTIL folder. Simply double-click on the file in Windows Explorer to run it.

Next, double-click on the **Add New Hardware** icon in Control Panel. Now follow the screen shots in Figs.5-9 to complete the installation.

As far as we're aware, Windows 2000 and XP both automatically detect the infrared device and install the appropriate drivers.

Hopefully, you now have a functional infrared transceiver. Now what do you do with it?

Uses

If you have a mobile phone with infrared support, then you can manage your phone numbers and messages as well as a bunch of other useful things. You do need additional software, though. The March 2001 issue featured an article titled "Mobile Magic" which covered this topic in detail.

If you have a portable computer (or a second desktop PC with an IR transceiver), you can use the support built into Windows to easily transfer files between systems – without wires! For Windows Me, 2000 and XP, you'll find a Wireless Link icon in Control Panel that provides simple file transfer capabilities (see Fig.13). Windows CE has similar capabilities, too.

Windows 95 & 98 don't have the Wireless Link icon, but if you check out Explorer's **Send To** context (right-click) menu, you'll notice that it contains a new entry called "IR Recipient" (see Fig.14).

You can also use Direct Cable Connect to network two machines together via their infrared ports. Note that Direct Cable Connect is an optional Windows component that may not be installed on your system. You can add it via the **Windows Setup** tab (look under the "Communications" heading) in **Add/Remove Programs**.

Before launching Direct Cable Connect, make sure that both the NetBEUI and IPX protocols are installed, and that both computers have the same workgroup name. You'll also need File and Printer Sharing installed and one or more folders or drives shared on the "host" computer.

There are many more uses for your new IR port. The 'net's a great place to start looking for ideas! You can start at **www.irda.org** SC

CIRCUIT NOTEBOOK

Interesting circuit ideas which we have checked but not built and tested. Contributions from readers are welcome and will be paid for at standard rates.

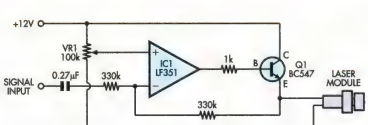


Fig.1: the analog modulator uses IC1 & Q1 as a unity-gain amplifier, with VR1 setting the DC output level.

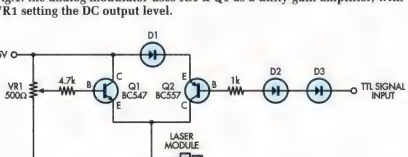


Fig.2: the digital modulator. Q1 provides a constant voltage to the laser module, while Q2 & diodes D1-D3 allow TTL or CMOS drive signals.

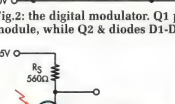


Fig.3: the photodetector circuit.

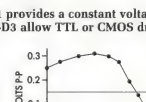


Fig.4: this graph shows the response of the analog modulator/ detector assembly.

Analog & digital modulation for laser pointers

There are a number of ready-made 1mW red (630-650nm) laser pointer modules available on the market (DSE, Jaycar, Oatley Electronics, etc) but the documentation is sparse and provides no stated way to modulate the light output. However, it is possible to get usefully modulated laser light beyond 80kHz using these modules and a handful of external components.

A typical laser module has a minimum supply voltage (1.9V in the units tested) at which light begins to be emitted. The maximum supply voltage and light output occurs at 4.7V. Supplying the module with a varying DC voltage between these values produces a varying light output.

On the reception side, detectors for laser light fall into two groups. Phototransistors have a rise/fall time of around 3µs to 10µs. Photodiodes have a higher f_t but in general are designed for infrared wavelengths and so have a poor response at 650nm.

Fig.1 shows the analog modulator. IC1 and Q1 act as unity-gain inverting amplifier (ie, a buffer), with trimpot VR1 acting as a level shifter to provide a permanent DC component. VR1 is set to provide 4.0V quiescent at the laser module's positive terminal. A 1V peak-peak sinewave of varying frequency was applied to the input capacitor and the light output measured using a BP103 phototransistor (Fig.3).

Light falling on the phototransistor acts as base current, turning the transistor on. The value of the series collector resistor R_S changes the sensitivity of the device. Increasing R_S makes the unit more sensitive to low light conditions, decreases the speed of operation, and increases the possibility of the transistor saturating (which further decreases the speed of operation).

The power rating of the BP103 is stated at 150mW, which limits the value of R_S at a supply voltage of 5V to a minimum of 42Ω. The overall frequency response of the combined modulator/detector assembly is shown in the graph (Fig.4).

The light output was sufficient to saturate the phototransistor despite the low value of series resistance, so an optical attenuator (consisting of several layers of translucent plastic) was placed in the light path to provide a quiescent output from the photo-transistor's collector +2.5V.

Note that the response time of the detector may be the limiting factor in the assembly's response. Lacking a fast phototransistor, I suspect that the module does top out at around 100kHz. when a 3:1 mark:space ratio pulse train is applied to the module and the frequency increased, the beam becomes appreciably brighter after 150kHz, suggesting that the module is not turning off to the same extent as at lower frequencies.

Digital circuits do not require a linear response, just an obvious difference between on and off (the more obvious, the better). The digital modulator (Fig.2) looks a bit like a 2-transistor differential amplifier but it is not. The 500Ω trimpot VR1 and Q1, a BC547 NPN transistor, provide a constant voltage to the laser module which sets the minimum brightness.

Q2 and the associated diodes allow TTL or CMOS circuitry to drive the

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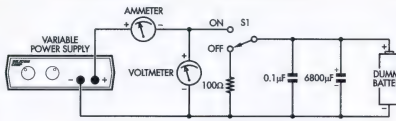
laser modules. A PNP transistor is used here because TTL can sink quite a bit of current but cannot source nearly as much.

Adjust trimpot VR1 with the TTL input disconnected (or high) to give about 2.4V on the module. The exact value depends on the module being used. Diodes D2 & D3 can be omitted when using CMOS or microcontrollers which switch to the supply rails.

The laser module came from Jaycar (ST-3115, $13.95), and the BP103 came from Oatley Electronics (part of the $10 Opto-Pack). Jaycar has a similar device to the BP103 (ZD-1950, $1.00).

The author would like to thank Doug Baly of Ultimo TAFE for his assistance with this project.

Tony Barry
South Brisbane, Qld.



Measuring the current drain of devices with DC-DC converters

It is often not possible to measure the current drain of modern consumer portable electronic devices by simply connecting an ammeter in series with the battery. Such devices, including digital cameras, digital notetakers, portable MP3, minidisc and CD players, often use only one or two AA or AAA cells and employ a DC-DC converter to step up the available voltage.

The waveform of the current they draw from the battery is a high frequency square wave with the peak current that's several times the average current. With such a high peak current demand, connecting even a relatively low resistance ammeter in series with the battery will often reduce the peak available current by so much that the device will refuse to operate.

The situation is complicated by the presence of sophisticated battery condition monitoring circuitry in many of these devices.

This circuit avoids these problems. A dummy battery replaces all of the cells in the device under test and a variable voltage power supply provides the power for the device. A 6800μF and a 0.1μF capacitor are wired directly across the terminals of the dummy battery to ensure a low supply impedance at both high and low frequencies.

The ammeter and voltmeter (which can be multimeters set to the appropriate ranges) monitor the current drain and actual supply voltage under load. By slowly reducing the voltage from the power supply, the device's behaviour can be observed as the "battery" runs down.

Some devices will shut off when the supply voltage is low (but not zero) and not respond even if the supply voltage is increased to normal – after all, batteries do not usually spontaneously recover their charge!

This is why the switch is included in the circuit. Setting the switch to the 'off' position simulates the removal of flat batteries. Then the power supply voltage can be set to that expected from a good battery and the switch set to 'on' to simulate the insertion of fresh batteries.

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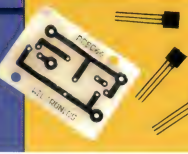

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SERVICEMAN'S LOG

A Panasonic kind of month

Some TV chassis share a common fault which can lead to over-confidence when it comes to servicing them. I was recently well and truly caught out but Lady Luck came to the rescue.

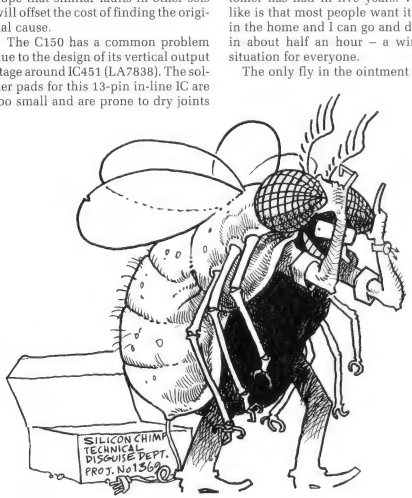
I have had a run of Panasonic C150 chassis TVs recently which have been good for me. These days, it is rare to get common faults and each one is its own proverbial pain in the backside when it comes to tracing it. So often, the time taken is too long to charge it all out to one job and one can only hope that similar faults in other sets will offset the cost of finding the original cause.

The C150 has a common problem due to the design of its vertical output stage around IC451 (LA7838). The solder pads for this 13-pin in-line IC are too small and are prone to dry joints and/or fractures in the solder, resulting in a variety of intermittent vertical scanning faults.

In Australia, there were only seven models employing the C150/C150A chassis released since its introduction in 1996. And more often than not, this is the first fault that the customer has had in five years. What I like is that most people want it fixed in the home and I can go and do this in about half an hour – a win-win situation for everyone.

The only fly in the ointment is the intermittent part, because invariably the fault won't show when I'm there. I can only go on the client's description of the problem and there are so many people who are not articulate or that accurate in their observations.

The worst scenario is when IC451 fails and results in the set being dead because of the load on the 12V rail (pin 1). Repeated failures of IC451 can be attributed to C455 (100µF 35VW).



~I HAD AT *LEAST* COVERED MYSELF WITH THE *FLYBACK* TRANSFORMER...

Caught out

Unfortunately, I was really caught out last month when Mr Peters brought his set, a TC-25R70AB, in with the fault description: "intermittent loss of picture and a horizontal white line".

I immediately took this to mean intermittent loss of vertical deflection and stupidly quoted on this basis. Naturally, I switched the set on and the picture was fine even when I belted it – my standard shock test for dry joints.

Still, I was extremely confident it was just dry joints on IC451 and so after waiting 10 minutes, I decided to resolder them. When I had finished, I replaced the back and put it aside for soak testing.

My confidence didn't last long. About 30 minutes later, I was walking past the set and was mortified to see that the display on the picture tube was now a pulsating bright raster with a white horizontal line in the centre.

I immediately returned the set to the operating theatre and removed the back. However, when I switched it on, it was back to working properly again – much to my frustration.

I persevered and noticed that after about 15-20 minutes, the picture would go through a series of very slight changes but mostly getting increasingly brighter until the screen was an uncontrollable white raster. It would then start to pulsate, with the picture geometry breaking up and an even brighter white horizontal line appearing in the centre.

Because it took so long to happen, I attributed this to heat causing a component to fail. But where? The other clue I thought I might have was the rust on the metal screen covers – no doubt due to the owner living close to the beach.

I started with a hairdryer and this did tend to support my theory that heat was causing a part to fail. Unfortunately, after emptying one and a half cans of extremely expensive freezer, I couldn't get the fault to reverse itself.

Next, I examined the rust/salt corrosion problem. This was mostly confined to the metal screening cans and was not visible on any component. Nevertheless, I sprayed the entire set with a fine mist of CRC 2-26 and then used the air compressor to make sure every part of the chassis was covered in a fine coating of oil.

But still the problem persisted. All the voltage rails checked out OK but I did notice some variations in the voltages applied to the CRT. These, however, could be restored by unplugging E/Y32 – the drive to the output transistors. I spent some time examining Q350 and its associated components, especially the diodes, and I replaced C350 and C360. But to no avail.

By now, I also noticed that in the process of getting brighter, the hue would change too – somewhat randomly. I checked the screen voltages and the screen control on the flyback transformer, because by now I had worked out that as it got progressively brighter, the set was unable to cope with the beam current. As a result, the flyback secondary voltages were dropping with the demand for power by the tube.

I must confess I did have some doubts about the flyback transformer but for now I was more interested in the jungle IC – IC601 (TA8844N). In the end, I decided to take the plunge and replace this 64-pin high-density device.

You can imagine my frustration when this made absolutely no difference.

What was missing?

So what was I missing? Well, as Mr Sherlock Homes would have noted to Dr Watson, I hadn't been concentrating on the details. As the picture began to go into its runaway failure, one of the first things it did was ever so slightly change its colours and produce Hanover blinds. Now, this was happening only very intermittently and very subtly but it turned out to be the main symptom when it came to determining the cause of the whole problem.

This symptom made it appear as though the set was being switched to NTSC and this is usually caused by problems with the line pulses. Line pulses are often used for clamping DC levels for the output stages, so it was well worth following this line ('scuse the pun) of investigation.

The horizontal (line) pulses are generated from the line output transistor via C509/C510 and fed around to pin 35 of IC601 via horizontal centring control R509. I put a CRO on the line and watched it. As the fault occurred, so the line pulses began to start changing shape and cause "ringing" immediately after the pulses. And when I saw it going through the "H. Center" control, I suddenly remembered reading a service bulletin about it.

I dug up the bulletin which was about "intermittent colour phasing/missing at top half of picture". Well, this was not really the problem we were faced with, though there were some similarities. I read on and it said these sets may have a problem with the colour content of the picture. It can either be a symptom where intermittently the top half of the picture may have missing colour, or the top half of the picture may have a colour phasing problem (green colour at top).

It went on but I was beginning to lose interest as these weren't the main symptoms I was getting. However, out of curiosity, I decided to vary the horizontal centring control (R509) and see what happened.

To my surprise, varying this control had a real effect on the symptoms. Fully anticlockwise, it was very bad but turn it fully clockwise and the symptoms would slowly vanish – and stay that way.

The Technical Information Sheet advised that R508 should be changed from 15kΩ to 27kΩ and C507 from 150pF to 330pF. I made these changes, reset the pot to centre the picture and that, as they say, was that. The fault was fixed completely!

Items Covered This Month

- Panasonic C150 chassis TC-25R70AB.
- Panasonic M19 chassis TC68GS90.
- Panasonic MX8 chassis TC68PS10.
- Panasonic M16M TX-33V2X.

Panasonic month

It's been mainly a Panasonic sort of month, with all sorts of models jumping out of the woodwork.

One 68cm 1997 TC68GS90 TV employing an M19 chassis once again found its way to the middle of my bench while my back was turned. I keep telling myself Mrs Serviceman that she mustn't allow these sets onto my bench while I'm doing important things – like making coffee – but it doesn't do any good.

This set was dead and apparently dead urgent too. Someone in the Ladies Bowing Club (which owned the set) has influence.

It didn't take massive amounts of brain power to discover that line output transistor Q552 (2SD2539LB306) was short circuit, as was D720 (RH3F). The only problem was why?

I switched the set on and sound and picture appeared in that order.

I BET *BRAIN* SURGEONS DON'T GET TREATED LIKE *THIS*...

But just as I had managed to tune in a station, the set died again. The same two culprits also got extremely hot before dying.

I had had a chance to see the picture before the set died and it was too small (about 20cm wide). What's more, there was a large east-west pincushion effect.

With only the above information to go on, I had to make an intelligent guess as to what the problem might be. As a result, I decided to order a new flyback transformer (T501), along with the other components that had failed again.

The boss wasn't impressed with the delays – the heat must have been on and I speculated that perhaps she was up to being elected to the committee. I was quickly reminded that it wasn't for me to speculate on anything other than the job at hand. I bet brain surgeons don't get treated like that.

Anyway, when the parts arrived and were fitted, I decided to cover myself and measure the B+ rail and a few other rails as well. I also connected the oscilloscope to the collector of Q552 to check the line pulse.

I switched it on and, of course, with a new flyback transformer, you have to reset the screen and focus controls before you can see the picture.

Oops! – too late. The two parts had failed again and were red hot. However, I did manage to check the voltage rails in time and was able to see that no change had occurred in the picture. Unfortunately, I missed the oscilloscope readout as it was on the wrong range and the set died before I was able to adjust the controls.

Well, my feeling was that I had at least covered myself with the flyback transformer and the two components were dying from delivering too much power into the east-west correction circuits. So that was where I had to investigate next.

The cathode of D720 is connected to the collector of Q552, while its anode goes to its partner D721 and to the X Board via D9, pins 7 and 8 and then to the line linearity coil and correction transistor Q703 via L722 and R765.

I took out the X Board and examined it very closely. I checked it for dry joints (there were none) before using a multimeter to check the main components. Q702 and Q703 were fine, as were all the coils, diodes and capacitors. Everything was looking fine but as a last resort, I decided to check the resistors too. (I really didn't have much more in the way of clues in the old kitbag). It was just as well because I found R765 (10Ω) to be open circuit. I put a new one in after checking everything else, fitted a new transistor and diode and gingerly switched it on again.

Now I wasn't really expecting much. I had been surprised that R765 was open, which made me think about Q702 and Q703 again – but I really couldn't see this as being responsible for blowing up the set.

But as usual, I was wrong. The set was now working perfectly and the offending parts were no longer getting hot. I soak tested the set for as long as I dared before informing the boss that it was ready.

A bizarre fault

The next story involves a bizarre fault. It too was a Panasonic, a 1999 model TC68PS10 with an MX8 chassis. In this case, the top 10cm of the picture was full of flickering big dots (not snow, though), stripes and lines and data – somewhat like data corruption. It was really weird and even happened when the video was muted out to a blue screen.

Well, where do you start with such a phenomenon? I could only think data, computers, micros – so I went for the microprocessor first (IC1101, MN1873284TF1), then the EEPROM (IC1102, 24LC08B1PA22) and finally the jungle IC (IC601, TB1237AN). To my frustration, changing them had no effect at all.

Surprisingly, it turned out in the end to be the tuner/IF module (TNR1, ENG39602G) that was the culprit. But having replaced all the other ICs, there really wasn't much left to change – except the cabinet!

Mr Edwards' 92 telly

Mr Edwards is a nice enough guy. He is semi-retired and lives with his wife in a modest house, with a private income from a block of luxury units. To look at him, you wouldn't think him to be a wealthy man – until you saw the TV. It was a 1992 Panasonic TX-33V2X using an M16M chassis.

So what, you say? Well, this was a pretty expensive telly back in 1992, even by today's standards. Back then, it cost about $5000 for this set which came with an 84cm picture tube and all the bells and whistles.

Despite its complexity, the M16 is a pretty reliable chassis. It was something of a watershed in Panasonic design and used plug-in modules, rather like the early M4 chassis of the seven-

ties. That is probably where the similarity ends but you get the drift – it's big, heavy (60kg) and complex.

So why was I doing a housecall on it? I can only put it down to the set being big and heavy and me being both optimistic and stupid. In mitigation, from Mr Edward's fault description, it could easily have been something simple – after all, he said it intermittently wouldn't start with the remote control.

Anyway, I thought it worth a look, so off I trundled to the Edwards' house.

I started by looking at the remote control and found that it is actually two remotes in one. One side has a simple, basic remote control, while the other side has a much more complex layout. It was obvious that this wasn't going to be easy to drive – especially as there were also a couple of tiny slide switches just inside the battery cover. And the 100-page(!) instruction booklet was like a small telephone directory.

I started by removing the batteries from the remote, thus disabling it, and tried switching on the set. The master on/off switch brought it onto standby, with the red power indicator coming on in the middle of the control door. One can never tell whether or not this is a fault condition, because most sets have an arrangement that when the power is switched off by the master switch, the set defaults to its last status – ie, if it was on standby, it will come on in standby and if it was on, it will come straight on.

The next trick was to find the standby/on switch on the front control panel. On this model, it is the program up/down buttons.

When I tried it, the set wouldn't come on. I then put the batteries back in the remote and the set still wouldn't come on. I wasn't one hundred percent sure how the set was meant to be switched on from standby, so I tried the volume 1 controls plus lots of other things as well but got no result. However, after many repeated attempts, the set suddenly came on. I tried the remote control and that now worked too – it even switched the set on and off very positively.

This was the worst scenario I could imagine. There was probably an intermittent fault within the monster and the only place to tackle that was my workshop bench – definitely not here.

However, muggins me decided to poke about inside and proceeded to remove the back. Inside, the only accessible modules are the S-Board (AC Filter), N-Board (Power In) and X-Board (Deflection Correction).

The all-important D-Board Power/Deflection is one of the mother boards and is almost totally inaccessible. I resoldered some potential dry joints on the S, N and X-Boards and reassembled it. Despite bashing the set, I couldn't make it go off so I then spent some time checking the tuning and set up.

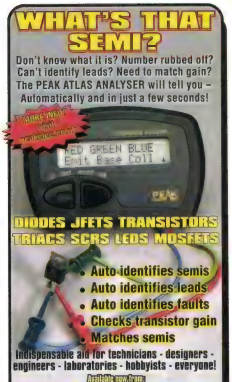
There were two other problems. First, the sound was only coming out of the lefthand speaker. Locating the menu for adjusting the balance control wasn't easy but I eventually found it under the "Auto/Function" menu on the set and the "Sound Menu" on the remote control. Readjusting it brought sound in the righthand speaker up correctly but I couldn't find a menu that would switch the annoying "MONO" indicator to "STEREO" every time I changed channel.

This set has two separate stereo decoders – "A2 (German)" Zweiton and Nicam Digital – which it can automatically select. The only control is choosing between "Stereo" and "Bilingual". Everything, I tried left it in the MONO mode so there was obviously a second fault here.

I discussed this with Mr and Mrs Edwards who agreed to try it as it was – they weren't too fussed about not getting stereo. Unfortunately, four days later, this all unravelled when Mr Edwards phoned to tell me the set wouldn't start again. I still thought that this might be due to a dry joint on the D-Board and so I called in and picked up the chassis so that I could rework it at the workshop. However, apart from a few dodgy connections, I couldn't find anything wrong.

It was then that I had an amazing bit of good luck. I was reading a technical magazine on repairing this very set and there, in black and white, were the two faults I had observed and the solution for both of them.

It all concerned the 5V rail from IC803 and, in particular, C885 and C889 (both 330µF 16VW). When these two electros dry out, the 5V rail drops to 4V, affecting the digital circuits. I replaced both parts on spec and took the reworked chassis back to the Edwards. I am happy to report that we had a good result. **SC**



TELEPHONE

Have you ever opened your phone bill and thought "Woh! No Way! I can't have made so many calls". This call logger will prove the point – who you called and for how long!

Design by Frank Crivelli – Article by Peter Crowcroft*

Most phone bills itemise long distance calls and give details of the number dialled. But local calls are just totalled up – you have no way of knowing who those calls were made to, or when they were made, or for how long.

What about small businesses that operate from home? They can usually claim a percentage of phone calls as a deduction for income tax purposes.

With the call logger, ALL outgoing call details are recorded and it is simply a matter of sorting them to determine how many were business calls.

You don't have to do a thing; all the data is recorded automatically. And all phones that use DTMF tone dialing are supported.

The logger records the start and stop time of outgoing calls along with the number dialled (plus any other digits pressed during the call – for example, BPay and credit card number entry). It operates "stand alone" – there is no need for any connection to a PC until you want to use the data.

When you want to analyse the data, it can be easily imported into Microsoft Excel. Various Excel functions can then be used to analyse and sort the data and produce formatted printouts.

Data is stored in non-volatile EEPROM memory, so there is no loss of data in the event of a power failure. The kit is supplied with 16K of memory and is expandable in 16K blocks up to 64K total. The circuit "auto detects" the amount of available memory – just plug it in and go.

The number of calls that can be recorded depends on the amount of memory installed and the number dialled. Each call requires the following minimum number of bytes:

- Start date & time - 6 bytes
- Stop data & time - 6 bytes
- Record terminator - 1 byte

Each digit dialled requires one byte. So, each call occupies 13 bytes of memory PLUS one byte for each digit dialled. Allowing for 11 bytes of system overhead (password storage), this leaves 711 x 10-digit phone numbers that can be stored in the basic design with 16K of memory installed [(16384-11)/23] bytes.)

PLEASE NOTE:

This is NOT an Austel-approved device. Anyone building this kit should make appropriate enquiries to ensure they are not contravening telecommunications legislation. Also, the use of telephone number and duration recording devices may contravene privacy legislation in some areas.

If your phone bill records more local calls than this (aah, so you have teenage daughters too?), simply install extra memory.

With the full 64K memory installed this is 2848x10-digit phone numbers. Ten digits is just taken as an example. If you are in a country where only 7 or 8 digits are used per call then you will get more calls stored. If you pay your bills by credit card then about 50 to 55 bytes will be used per call.

Access to all logger functions, including downloading of call data, is password protected.

Three LEDs are provided on the front panel to indicate power on, offhook (call in progress) and memory status. The memory status LED flashes when the memory is 75% full and is permanently on when 100% full.

As a bonus, call data is also output in "real time" to the serial port as well as being recorded in memory. This is useful when immediate call analysis and/or external data logging are required. This "real time" output is unaffected by the memory status – even if the memory is full the call data is still output.

You can attach this serial output to the parallel port of a printer by going through a serial to parallel converter. These interface boards are readily available commercially.

Phone line connection

Two RJ12 (USA-type) telephone sockets are available on the rear panel, marked "LINE" and "PHONE". The telephone line connects to the "LINE" connector and an optional telephone can be connected to the "PHONE" connector. This allows a telephone to be connected and used even when the logger is put in its place. Telephone line cords are not supplied with the logger kit but are very commonly available.

The project is constructed on a dou-

The logger is housed in a small plastic case and is fully self-contained. It does not need to be connected to a PC until you want to download the data which is stored in EEPROMs.

ble-sided, plated-through hole PC board and fits in a plastic case measuring 130(W) x 100(D) x 30(H)mm. Screen-printed front and rear panels are supplied.

The kit requires a 9-to-12V DC power supply. A 12VDC plug-pack rated at 300mA is suitable.

Circuit description

The kit is controlled by a preprogrammed 89C2051 microcontroller from Atmel (U3). This was chosen because it has the required number of I/O pins and an inbuilt serial port. It has 2K bytes of flash memory which is pre-programmed with the control firmware.

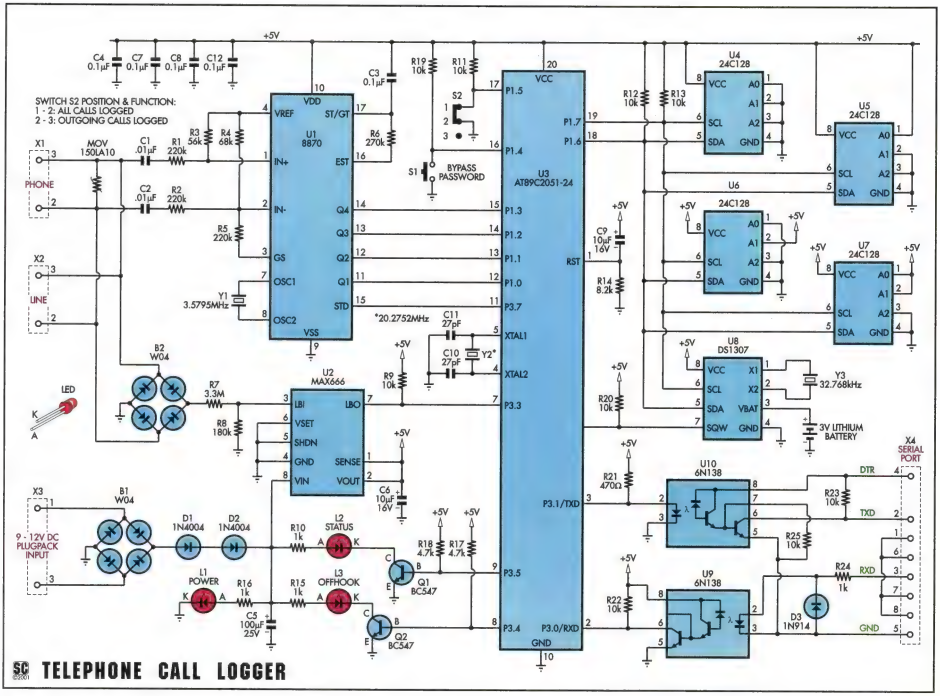
U2, a Maxim MAX666, provides two functions:

1: 5V regulator (via pin 2) to power the rest of the circuitry. The diode bridge B1 provides polarity protection. The MAX666 maximum input voltage is 16.5 volts. Some 12V (nominal) plugpacks actually deliver a lot higher voltage at low output currents, up to 17V in some cases. Diodes D1 & 2, along with B1, allow voltages up to 19V to be used to power the kit.

2: Low Battery Detect, intended for use with battery powered equipment. In this application it is used to detect when the telephone line is 'looped' (in use). The DC voltage of a telephone line is nominally 48V. This drops to around 12V or less when looped. The chip detects this voltage drop and pulls pin 7 low. Diode bridge B2 provides polarity protection on the tele-phone line.

U1 (MT8870CE) is a DTMF decoder. It connects to the telephone line via resistors R1 and R2 and capacitors C1 and C2. When a DTMF tone is de-

The rear of the case has four sockets. The telephone line connects to the "line" socket and you can plug a phone into the other RJ12 socket.



TELEPHONE CALL LOGGER

tected, pin 15 goes high and the 4-bit digit data is presented on pins 11-14. The metal oxide varistor (MOV) protects the kit from damage by any short duration high-voltage spikes on the telephone line.

All clock/calendar functions are provided by U8 (DS1307), a Serial Real Time Clock from Dallas Semiconductor. Using a 2-wire I^2C serial interface to communicate with the microcontroller, it features real time clock counts for seconds, minutes, hours, date of the month, month, day of the week and year with leap year compensation valid until 2100. It has a square wave output (pin 7), programmed to give a 1-second signal. This is used by the microcontroller firmware to flash the memory status LED. The chip also features automatic power-fail detect and switch circuitry. The 3V lithium battery provides backup power during a power failure.

Non-volatile memory storage is provided by up to four AT24C128 EEPROMs. These also use a 2-wire I^2C serial interface like the clock chip. The EEPROMs are 128K bit types organised as 16K x 8. At least one EEPROM must be present. The rest are optional and can be inserted in sequence by the user as required.

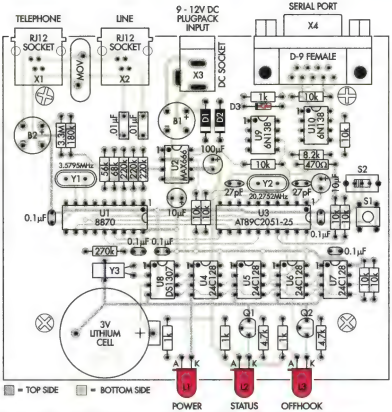
Two switches are provided. S1 is a pushbutton type and is used for 'password bypass'. S2 is a slide switch and is used to set the type of calls recorded. More on these later.

The serial interface is a bit unusual. It is not the regular type offering RS232 type signal levels. Instead we have used two high-speed optoisolators, U9 and U10.

These were necessary to provide complete electrical isolation between any PC connected to the serial port and the telephone line.

An RS232 interface uses a common 'ground' signal between each end of the interface. At the PC end this 'ground' signal is connected to mains earth. This mains earth would then be connected to the telephone line via on-board circuitry in the data logger. Since both sides of a telephone line are normally 'floating' above earth, earthing one side of the line would cause a fault condition at the telephone exchange and the line would stop working properly.

The solution is to use an opto-isolated serial port for connection to a PC. Otherwise the kit would have to



The PC board for the Telephone Call Logger is double-sided – make sure you mount the components from the top (this view looks down on the top side)

be disconnected from the phone line before connecting a PC to it. It would also mean that a PC could not be permanently connected to capture the 'real time' output from the logger.

The receive side of the serial interface (U9) is simple. The RS232 voltage levels from the PC drive the LED in U9 via R24. Diode D3 protects the LED from reverse currents when the RS232 level goes negative.

The transmit side of the serial interface (U10) requires a positive voltage to bias the output transistor.

To maintain electrical isolation, this voltage is provided by the PC side of the interface via the DTR line. The 'active' state of DTR is +12V (nominal). R23 is the collector load resistor for U10's open-collector output, while R25 provides bias for the Darlington output stage, reducing the turn-off time of the output.

What about the power supply you say? Yes, it also must be isolated from mains earth. This is not really a problem when using a plugpack. Plugpacks normally use a 2-pin connection to mains (no earth pin). They also use a transformer to convert the mains voltage, which provides further electrical isolation from earth.

Construction

The PC board has the component overlay printed on it. This is the same as the diagram above. Use the component overlay and the photographs to help with the assembly. Note that the LEDs are left until last.

The following is a suggested order of assembly:

1. Resistors and diodes. Put in the four 1% metal film resistors (R3-6) around the DTMF decoder first.
2. IC sockets
3. Crystals and capacitors. Use a resistor lead offcut to hold down crystal Y3 against the PCB.
4. Transistors and the two switches
5. Battery holder and diode bridges
6. DC jack and D9 connector
7. Both telephone connectors
8. Metal Oxide Varistor (MOV). Push this as **far down onto the PC board** as possible. It is tall and will need to be pushed right in so the lid will fit. Do not insert any ICs yet.

The plastic box is in two halves. Take the bottom half and fit the rear panel into the slot provided. Now drop in the PC board and slide it back so that the telephone and D9 connectors protrude through the panel. Fix the PC board into place using the four

self-tapping screws provided.

Now comes assembly of the front panel. Start by inserting the three LED clips into the holes, pushing them in from the front. Insert the LEDS into the clips from the rear. The LEDs should "click" into place.

Turn the LEDs in the clips so that the long lead is to the left when viewed from the front. This means that the flat edge of the LED (short lead, cathode) will be to the right when viewed from the front and will correspond to the flat marked on the overlay. This is very important so make sure it is right.

Now bend the leads down at right angles, about 3mm from the LED body, as shown in the diagram.

Use a pair of long-nose pliers to hold the leads while bending. Cut the leads off to a length of about 9mm from the bend.

Position the front panel on to the case and drop it into place, making sure that the LED leads are inserted into their matching holes on the PC board. Once the panel is in place solder the LED leads **from the top of the PC board.**

Insert the 5V regulator IC, U2 (MAX666), into its socket. Connect a power supply to the DC jack. The power LED on the front panel should light. Measure the DC voltage output of the regulator. The easiest place to do this is to measure across pins 10 (GND) and 20 (+5) of the U3 IC socket. It should read very close to 5V.

If OK, disconnect the power and insert the rest of the ICs. Take care that the ICs are the correct way around and none of the leads are bent under the body of the IC or miss their places in the IC sockets.

The EEPROM (24C128) ***must*** be inserted in position 'MEM 1' (U4). Any extra EEPROMs must be inserted in order from left to right starting at 'MEM 2' (U5). The DS1307 clock/calendar chip, U8, is located to the left of all the EEPROMs.

The lithium battery is inserted in the battery holder with the positive side up. Note we have a lithium battery because fresh CR2032 batteries are readily available everywhere. You would not want a kit with a flat battery!

Do not fit the plastic case lid just yet. Proceed to the section "Installation and setup".

Serial port parameters

Any communications program used to 'talk' to the logger must configure its serial port to:

9600 baud, 8 data bits, 1 stop bit, no parity bit

No 'handshaking' or 'flow control' is used. The logger **does** require that the DTR line is 'active', ie +12V. This is the default for most comms programs anyway.

Installation and setup

The logger needs to be 'set up' before use. You will need a PC running a communications program. Any comms program will do. Windows users can use HyperTerminal, which comes with Windows itself. We use our own **term.exe**. which you may download from:

http://kitsrus.com/zip/term.zip

The zip file includes a detailed explanation of how to set up and use term.exe under Windows 98.

- Connect a PC to the logger via one of the serial ports. Use a 9-way, male-to-female 'straight though' cable.
- Start the comms program and set the serial port parameters as described

Parts List - Telephone Call Logger

1 Plastic case, 130(W) x 100(D) x 30(H)mm
1 PC board, 102 x 86mm, coded K164
1 Set of front & rear panels
1 Battery holder
2 RJ12 (6-way 4 pin) phone connectors
1 2.5mm DC Jack
1 female D9 connector PCB mounting
8 8-pin IC sockets
1 18-pin IC socket
1 20-pin IC socket
3 LED clips, 5mm black
1 Pushbutton switch
1 SPDT Slide switch
1 Lithium battery, 3V CR2032 or equivalent (not supplied in kit)
4 Self tapping screws for fixing PC board to case
1 3.579MHz crystal
1 20.2752MHz crystal
1 32.768kHz crystal, tuning fork type
1 metal oxide varistor (MOV)

Semiconductors

2 1N4004 power diodes
1 1N4148 signal diode
2 WO2 bridge rectifier
2 BC547 NPN transistors (Q1, Q2)
3 LEDs, 5mm red
1 MT8870CE DTMF receiver (U1)
1 MAX666 5V regulator (U2)
1 AT89C2051-24PC (Pre-programmed with K164 firmware) (U3)
1-4 AT24C128 Serial EEPROM (1 supplied with kit – see text) (U4-U7)
1 DS1307 Serial Time Clock (U8)
2 6N138 or 139 optocoupler (U9, U10)

Resistors (0.25W carbon film unless specified)

1 3.3MΩ	1 270kΩ*	1 220kΩ*	2 220kΩ	1 180kΩ	1 68kΩ*
1 56kΩ*	9 10kΩ	1 8.2kΩ	2 4.7kΩ	4 1kΩ	1 470Ω

*1% metal film

Capacitors

1 100µF 25V electrolytic
2 10µF 16V electrolytic
5 0.1µF MKT polyester (104 or 100n)
2 .01µF MKT polyester (103 or 10n)
2 27pF ceramic (27 or 27p)

Here's how to bend the LED leads so they are a neat fit in the front panel and the PC board. Use a pair of needle-nose pliers to grip the lead and bend against.

above. Make sure the correct serial port is selected.

- Power up the logger. A banner is printed showing the firmware version number and the amount of EEPROM memory installed.
- Hold the "PWD BYPASS" switch (S1) down and press the 'Enter' or 'Return' key on the PC keyboard.
- A menu will be displayed, as follows:

1. Download data
2. Clear data
3. Set date
4. Set time
5. Change password
0. Exit

- Set the date – option 3. The current date will be displayed and you will be prompted to enter the new data. The date is entered as "mm/dd/yy" (including the '/').

Note: The logger does **not** check for valid dates. For example, if you enter "15/66/01" it will accept it.

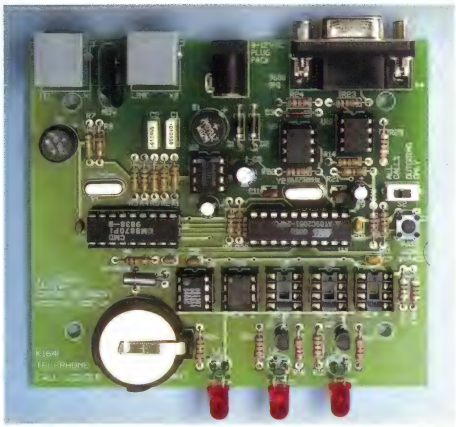
- Set the time – option 4. The current time will be displayed and you will be prompted to enter the new time. The time is entered in 24-hour format as "hh:mm:ss" (including the ':').

Note: As with the date, the logger does **not** check for valid times. For example, if you enter "29:77:99" it will accept it.

- Set the password – option 5. You can use any letter, number or punctuation mark but it must be at least four characters long, up to a maximum of eight characters.

Note: Lower and upper case letters are treated as different characters; eg, the lower case letter 'a' is not the same as capital 'A'.

- The last thing is option 2 - Clear data. This **MUST** be done so that the memory is initialised correctly.
- Now exit the menu using option 0. A "READY" prompt is displayed.



Compare the PC board photograph with the component overlay. The component overlay is also screened onto the top side of the PC board.

Select the type of calls to log, as described next.

Types of calls

The logger has an on-board switch (S2) that is used to select the type of calls to record. A call is defined as any time the phone line is looped (that is, the handset is picked up & the OFFHOOK LED is on.)

Types of calls are defined as:

1. **Outgoing Calls Only**
   These are calls where the handset is picked up and at least one digit is dialled. If no digits are dialled, no data is recorded.
2. **All Calls**
   Data is recorded any time the line is looped, regardless of whether any digits are dialled or not. If no digits are dialled then it was probably an incoming call.

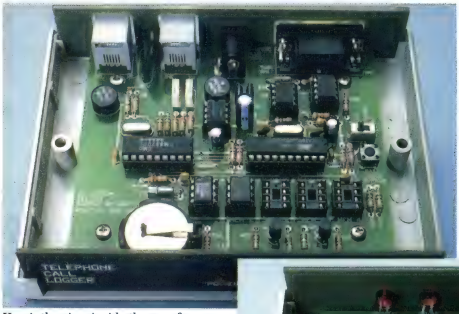
The logger does not have 'caller ID' circuitry and is not able to record the phone number of incoming calls.

Testing

Use a telephone line cord to connect the logger to the telephone line via the 'LINE' connector on the back of the logger and connect a suitable power

Table 1: RESISTOR COLOUR CODES

No.	Value	4-Band Code (1%)	5-Band Code (1%)
1	3.3MΩ	orange orange green brown	orange orange black yellow brown
1	270kΩ	red purple yellow brown	red purple black orange brown
3	220kΩ	red red yellow brown	red red black orange brown
1	180kΩ	brown grey yellow brown	brown grey black orange brown
1	68kΩ	blue grey orange brown	blue grey black red brown
1	56kΩ	green blue orange brown	green blue black red brown
9	10kΩ	brown black orange brown	brown black black red brown
1	8.2kΩ	grey red red brown	grey red black brown brown
2	4.7kΩ	yellow purple red brown	yellow purple black brown brown
4	1kΩ	brown black red brown	brown black black brown brown
1	470Ω	yellow purple brown brown	yellow purple black black brown



Here's the view inside the case from the front (above) and back (right). Everything mounts on the PC board.

supply (12VDC plugpack).

Once connected to the phone line we can test that it is actually recording calls. Connect a PC to the logger and run the comms program. This will enable us to see the 'real time' output.

Now pick up the phone. The 'OFFHOOK' indicator should light and the current date and time printed on the PC screen. Dial a few digits – they should be displayed as they are pressed. Now hang up. The 'OFFHOOK' indicator should go off and the date and time printed on the screen.

Now we will check if the data was recorded into memory. Press the 'Enter' or 'Return' key on the PC keyboard. You will be prompted for a password. Enter your password. You only have five seconds to start and between each character. If the password is correct a menu is displayed. Choose option 1 – Download data. The call you just made should be displayed there.

Notice that the recorded format is slightly different to the 'real time' output. In the 'real time' output, everything is printed as it happens; ie, the START date/time, followed by the digits dialled, followed by the END date/time. The recorded format has the START date/time followed by the END date/time followed by the digits dialled. This makes the data easier to read if simply making a printed copy.

Operation and use

The logger does not need a PC connected to log calls. A PC is only required to set or check the onboard clock and download any recorded call data.

If the data memory becomes full the logger will not log any more calls. In this case connect a PC and download the data (see "**Saving call data to a disk file**"). Once saved, the memory MUST be cleared for the logger to continue logging further calls.

NOTE: the logger will not log any calls while the menu is displayed. **You must exit the menu (enter '0') to resume normal operation.**

What if I forget my password?

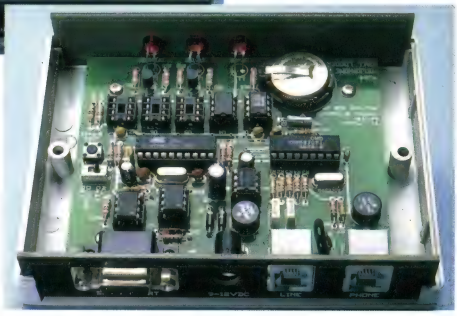
In this case you will need to remove the lid from the logger and hold down the 'PWD BYPASS' switch before you press 'Enter' or 'Return'.

Adding more memory

The logger uses up to 4 x AT24C128 EEPROMs for data storage. Each EEPROM is 16K bytes giving a total of 64K of memory. Only one EEPROM (16K) is supplied as standard with the kit.

The memory is user upgradeable by simply 'plugging in' more EEPROMs. Disconnect the power and telephone line and remove the lid. Insert the EEPROM(s) according to the following table.

Memory	Position
16K	MEM 1 (mandatory)
32K	MEM 1, 2
48K	MEM 1, 2, 3
64K	MEM 1, 2, 3, 4



What do the lights mean?

POWER indicates that power is connected to the logger.

OFFHOOK indicates that the phone line is looped (in use). It will only indicate if the line was looped AFTER the logger was connected. If the line is already in use when the logger is connected then the indicator will be remain off until the NEXT time the line is used.

STATUS indicator has a number of meanings. It is used to indicate the amount of memory left for logging calls. When the memory capacity reaches 75% full the STATUS light starts flashing. When the memory is completely full the light is permanently ON and no more calls will be logged.

If the STATUS light is permanently ON it could indicate battery failure on the clock. If the battery has failed then the clock data may be corrupted or

incorrect. In this case you will need to use the logger's menu to check the date and time. Test the battery and replace if necessary.

If both the STATUS and OFFHOOK lights are ON when the logger is powered up it means that the logger could not detect any EEPROM memory at all. If you connect a PC to the logger and run a comms program you will see the words "MEMORY ERROR" continuously printed. Check that there is an EEPROM in position 'MEM 1' or re-seat the chip if one is present.

Download data format

The recorded call data is printed out in the following format:

|—Start date and time—| |——End date and time——| |-digits dialled—| (dd-mon-year hours:mins:secs, dd-mon-year hours:mins:secs, all numbers pressed)

The date is of the form "12-May-01" and the time is in 24-hour format as in "13:30:00" (1.30pm). Each data record (call) is terminated by a "carriage return/line feed" combination.

Saving call data to a disk file

Now all the call logged data is sitting in MEM1 (and MEM2, 3 and 4 if present.) We want to get this data from these IC(s) into our PC. How do we do this?

Answer: we download the data using a 'comms', or communications, program running on a PC that 'captures' the data to a disk file as it is displayed on the screen. All comms programs have a 'data capture' or 'logging' function where everything displayed on the screen is also saved to a disk file. The file is a simple ASCII text file. Windows 9x has its own comms program, HyperTerminal, built in and you can use this. But we use **TERM.EXE**, our own program which can be downloaded from our website http://kitsrus.com/zip/term.zip

The file includes a detailed explanation of how to set up and use **TERM.EXE** under Windows 98.

The following description assumes you are running **TERM.EXE**. (Similar event sequences apply to all comms programs.)

Connect your PC to the logger and start term running by clicking on the **TERM.EXE** icon. After the screen has appeared press 'Enter'. You will be prompted for a password. Enter the password and a menu will be displayed. (The phone must not be in use – offhook LED lit – when you do this.) If you do not enter your password within 5s the software will return to ready mode and will log data. Hit Enter to get the password prompt back.

After successful password entry you will get the Menu. Now turn on 'data capture' by pressing alt-L. You should be prompted for a file name to save to (term.log is the default). Hit Enter. LOG will appear on the bottom line of the display to show logging is on. Then choose option 1 – Download data. Hit Enter. All recorded data will be printed out (in the format described previously).

When finished, turn off 'data capture' by pressing alt-L again. Note that LOG disappears from the bottom line. All the data has now been saved to the disk file 'term.log'. Finally, press '0', press Enter – the logger will exit the menu and return to normal operation. To exit TERM.EXE hit alt-Q. Note logging must be turned off to allow you to exit from TERM.EXE.

Note that you cannot stop the scrolling of the data after you press '1'. The whole data in the EEPROMs is dumped to term.log in one go. You have to go to term.log with a text editor to look at the individual data lines or load it into Excel as described next.

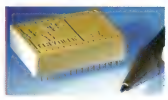
Importing data into Excel

The data in term.log is in a format that can be easily imported into Microsoft Excel. First, edit term.log to remove unwanted data from the start and end of the file. Once done the data can now be imported into Excel.

The following step-by-step guide will show you how to import the file into Microsoft Excel. It has been tested using Excel 97 and 2000.

1. Click on "File, Open"
2. In the 'Files of type' box select 'All Files (*.*)'
3. Browse to the saved data file, select it and click 'Open'
4. A 'Text Import Wizard' dialog box will appear. Under 'Original data type' select 'Delimited'. Click 'Next'
5. A second dialog box will appear. Here you can choose which delimiters to use to break up the file into columns. If you want the data and time to be one column then select 'Comma' only. If you want the date and time to be separate columns (recommended) then select both 'Comma' and 'Space' as delimiters. A preview will show you

The Tiger comes to Australia



The BASIC, Tiny and Economy Tigers are sold in Australia by JED, with W98/NT software and local single board systems.

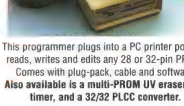
Tigers are modules running true compiled multi-tasking BASIC in a 16/32 bit core, with typically 512K bytes of FLASH (program and data) memory and 32/128/512 K bytes of RAM. The **Tiny Tiger** has four, 10 bit analog ins, lots of digital I/O, two UARTs, SPI, I²C, 1-wire, RTC and has low cost W98/NT compile, debug and download software.

JED makes four Australian boards with up to 64 screw-terminal I/Os, more UARTs & LCD/keyboard support. See JED's www site for data.

TIG505 Single Board Computer

The TIG505 is an Australian SBC using the TCN1/4 or TCN4/4 Tiger processor with 512K FLASH and 128/512K RAM. It has 50 I/O lines, 2 RS232/485 ports, SPI, RTC, LCD, 4 ADC, 4 (opt.) DAC, and DataFLASH memory expansion. Various Xilinx FPGAs can add 3x 32bit quad shaft encoder, X10 or counter/timer functions. See www site for data.

$330 PC-PROM Programmer



This programmer plugs into a PC printer port and reads, writes and edits any 28 or 32-pin PROM. Comes with plug-pack, cable and software.

Also available is a multi-PROM UV eraser with timer, and a 32/32 PLCC converter.

JED Microprocessors Pty Ltd

173 Boronia Rd, Boronia, Victoria, 3155

Ph. 03 9762 3588, Fax 03 9762 5480

www.jedmicro.com.au

how choosing each delimiter affects the file. Click 'Next'.

6. A third and last dialog box appears. Here you can choose how Excel interprets each column of data. Select each column in turn and set the 'Column data format' to 'Text'. Click 'Finish' when done.

Calculating call duration

Once you have imported the data we can use Excel's date and time functions to calculate the length of each call. We can then sort the file into order starting with the longest duration call first.

The data should have been imported in five columns labelled as follows:

Column	Data
A	Start date
B	Start time
C	End date
D	End time
E	Digits dialled

The data should start in row 1. We will now create a column of data that is the duration of each call.

1. Click on cell 'F1'
2. Type in the following formula:
   =DATEVALUE(C1)
   +TIMEVALUE(D1)
   -DATEVALUE(A1)
   -TIMEVALUE(B1)

This tells Excel to subtract the start date (A1) and time (B1) from the end date (C1) and time (D1).

3. Click on cell 'F1' again
4. From the menu select "Format Cells"
5. The "Format Cells" dialog box will appear. In the 'Number' tab under 'Category' list select 'Time'. Under 'Type' select '37:30:55'. The call duration is now shown in "hours:minutes:seconds" and can span multiple days.

We now want to copy this formula and formatting to the rest of the cells in this column down to the last data entry.

6. Click on cell F1 again. This cell contains the formula and formatting information we need.
7. Drag the fill handle over the cells to be filled.

The fill handle is the small black square in the corner of the selected cell (F1). When you point to the fill handle, the mouse pointer changes to a black cross.

The cells should now contain the duration of each call.

Note: some calls may span across midnight from one day to the next. In this case the end time will be earlier than the start time. Using the Excel DATEVALUE and TIMEVALUE functions allows the correct time duration to be calculated.

Sorting the data

The data can be sorted in any order using any column as required. The following example sorts the data according to call duration (as calculated previously).

1. Click on any data cell
2. From the menu select "Data Sort"
3. The 'Sort' dialog box will appear. In the 'Sort by' box select Column F (the call duration column) and 'Descending'
4. Click 'OK'

The call data is now sorted by call duration with the longest call first.

Of course you can sort the data in any order you like. Using the 'digits dialled' column will sort the data by phone numbers dialled, with all similar numbers grouped together.

Sorting by "start time" will group all numbers dialled at a certain time of day.

Wheredyageddit?

The copyright in this design, including PC board, is retained by the authors. Kits are available from Ozitronics (**www.ozitronics.com**) for $116.00 plus GST

*You can email the authors – **peter@ kitsrus. com** if you have any problems or requests.

For any technical problems or questions, contact the kit developer, **frank@ozitronics.com**

Information on other kits in the range is available from our Web page at **http://kitsrus.com**

If it does not work . . .

Poor soldering ("dry joints") is the most common reason for the circuit not working. Check all soldered joints carefully under a good light. Re-solder any that look suspicious. And then check:

- Are all the components in their correct position on the PC board?
- Are the electrolytic capacitors the right way round? What about the diodes and diode bridges?
- Are the ICs the right way around?
- Are any IC leads bent up under the IC body (ie, not in the sockets)?
- Is the regulator output = 5V?
- Is it connected to the telephone line?
- Is it connected to the right serial port on your PC?
- Are you using a straight through serial cable?
- Is the correct serial port selected in your comms program?
- Is the serial port configured correctly? Is DTR active (+12V)?
- Is an EEPROM inserted in position "MEM 1" (U4)? SC

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Bench Lamp With Exhaust Fan

A great product for every workbench. The inbuilt exhaust fan extracts annoying fumes such as solder or solvents, etc. Looks like our magnifying lamp but is fitted with a fan instead of magnifying lens. Cantilever swivel mount arm and secured to your workbench by screw clamp. 22W fluoro tube; arm almost 1M in length, with light and fan switched independently. Cat. QM-3540 $159

NEW

MORE PARTY GEAR INSIDE

Cool Tubes - Blacklight Sensitive Tubing

NEW

With Cool Tubes you can make signs, masks, theatrical props and artwork – uses limited only by your imagination! Cut the tube to length, insert the wire and bend to shape and, when placed near a blacklight source, the tube will glow like neon! Kit includes 4 x 1.5 metre rolls of coloured tubing, shaping wire and dozens of clips & joiners. Colours included are orange, blue, green & pink. Cat. SL-3180 $12.95

OUTDOOR & POWER PRODUCTS

LED Illuminated Whistles

NEW

Ravers and niteclubbers will relate to these – but have you ever seen an ILLUMINATED whistle! The translucent section of the whistle glows with an enchanting light and can be selected to flash at the press of a button. Chrome barrel & clear whistle 89mm length x 10mm diameter and supplied with an approximate 44cm ball lanyard chain.

$11.95ea

RED Cat. ST-3093 Available Approx. Dec 7th
GREEN Cat. ST-3094 BLUE Cat. ST-3095

LED Glowlight Pens

Twist action delivered pen nib plus switch-activated LED for writing in stylish LED lit colour! An ideal X'mas gift.

NEW

BLUE Cat. ST-3066 $11.95ea

RED Cat. ST-3065
GREEN Cat. ST-3067 $9.95ea

Piezo Pocket Gas Torch

NEW

A lightweight, handy pocket torch ideal for camping, heating small objects, lighting fires in windy conditions etc! Measures 40 x 75mm and refills with standard Butane gas such as our NA-1020 gas. Cat. TS-1662 $19.95

Ultraviolet Super Bright LED Keyring Torch

NEW

Our latest addition. This model produces a bright UV light for fun at niteclubs or as a UV source to quick check for UV water-marks on most international currency, credit cards, etc. Cat. ST-3043 $14.95

FULL COLOUR RANGE INSIDE

Spark Plug LED Keyring Torch

NEW

Super Bright

One for the auto enthusiasts! This tiny torch looks just like a real spark plug but is really a sophisticated LED torch. Powered by three mini button cells (included). Cat. ST-3068 White or ST-3069 Blue $14.95ea

Laser Pen

NEW

A great product for lecturers, students or even tradespeople. Features a metal barrel, twist action pen and soft push button to activate the laser. Batteries supplied. Size 135mm length x 13mm approx. dia. Cat. ST-3090

Available Approx. Dec 7th $19.95

Lab Micro Burner

NEW

This burner will find many uses in both laboratory and domestic applications such as science experiments, R&D labs, dental, hobby and general craft work. Features non-slip base, piezo ignition, carry handle, adjustable flame to 1300C. 85(H) x 125mm across the handle. Cat. TS-1664 $49.95

Bench Stand For Micro Lab Burner

NEW

Designed for use with the TS-1664 burner and ideal for supporting small beakers and test tubes in the lab. Measures 110mm across the base and 110mm high. Assembly instructions included. Cat. TS-1665 $12.95

HOBBY ZONE INSIDE

6" Blacklight Glow Stick

NEW

Dazzle your friends with this blacklight glow stick. Simply snap and shake to produce a bright blacklight for fun at dance parties, etc. Cat. ST-3175 $4.95

This is not a UV lightstick.

FULL COLOUR RANGE INSIDE

LED SANTA DISPLAY KIT

Build now for Christmas!

Enhance your Christmas spirit with this exciting LED display kit. The kit uses over 600 high brightness LEDs to create a colourful and eye-catching display which measures almost a metre across. Cat. KC-5302 $169

Multi-Colour LED Glowlight Pen

NEW

We're not sure if the inventor of the ballpoint pen had this in mind, but we suspect they would have been suitably amused with this funky pen! Once activated, the pen's clear barrel floods with changing, flashing colours, changing flash rate and fading from one colour to the next. Amusing and unique! Cat. ST-3092 $24.95

Available Approx. Dec 7th

NEW PRODUCTS Sometimes new products advertised here are held up due to unforseen circumstances. Before driving across town, please phone to check that the new products have arrived in your store.

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8" Mirror Ball Set

This party kit contains everything you need to create your own disco at home. Kit includes 20cm ball, rotating stand, par 36 bulb, and 4 colour filters.
Cat. SL-2983
WAS $99
$89 SAVE $10

3 Way Linkable Lighting

This is a musicolour, with coloured spotlights flashing to the music. Controller will take up to 6 light modules. Includes 3 globes.
$129
Cat. SL-2950

Extra Modules

Globe not supplied.
Cat. SL-2952
$22.50

Globes

Orange Cat. SL-2953
Purple Cat. SL-2954
Red Cat. SL-2955
Green Cat. SL-2956
Blue Cat. SL-2957
Yellow Cat. SL-2958
$7.80ea

Lighting Stand

This strong and sturdy lighting stand will extend from 1530mm to 3650mm tall and carry support a weight of up to 20kgs. See cat P251 for details.
Cat. CL-2800
$119

12" Coloured Mirror Ball

Any spotlight will do – no need to buy special coloured lights!
Features red, clear, blue, yellow and green tiles.
Cat. SL-2981
$55

Fog Machine

Combine one of these with a strobe light for awesome lighting effects! See cat. P252 for details.
Cat. AF-1200
XMAS **$139** SAVE $36
Fog Juice 5 Litres
Cat. AF-1205 **$34.50**

Mirror Balls

One of these mirror balls is just what you need to add a bit of life to your next party. Use in conjunction with 1 or more of our Pan 36 pinspots for an amazing light effect. See cat. page 250 for details.

8" Ball - Cat. SL-2980 **$24.95**
12" Ball - Cat. SL-2982 **$43.95**

Mains Powered Mirror Ball Motor

240VAC powered suitable for 8 & 12" balls. See cat. P250.
Cat. SL-2984
$24.95

Battery Powered Mirror Ball Rotator

Single D cell required – not included. Suits 8" ball only. See cat P250. Cat. SL-2985
$19.95

20" Colour Changing Neon Tube

3-way switch selects coral pink, neon blue or constant change from one to the other. Create an unusual ambience at your next party. 12VDC powered. Length 500mm. See cat. Page 253. Cat. ST-3138
$64.95

PARTY SPEAKERS

12" model 100WRMS
15" model 120WRMS
As the party progresses, so does the volume and, if you're unfortunate enough, damage to your beloved hi-fi speakers generally ensues! These rugged, low cost party speakers are designed to 'stand in' in the place of your expensive hi-fi speakers.
See cat. Page 216 for details.
12" model 100WRMS Cat. CS-2512 **$159ea**
15" model 120WRMS Cat. CS-2515 **$209ea**

15" model shown

Rotating Party Lights

Similar to emergency vehicle lights, these lights are available in two colours - red & blue. 240VAC powered. 180(H) x 157(base)mm. See cat. page 253.
Cat. SL-2987 Blue
Cat. SL-2986 Red
$42.95

Low Cost Karaoke Microphone

Excellent value! Built-in on/off switch, unidirectional, dynamic microphone with 6.5mm phono plug. See cat. Page 231 for our full mic range. Cat. AM-4090
$14.50

Ropelights – 5 Great Colours to Choose From

6 metres long, 240V operated. 8 exciting light effects such as 'chase', 'sperkle', 'slow fade', etc. Rope is waterproof.
Cat. SL-2821 to SL-2825
$49.95

6" Light Sticks

NEW

Once activated, Light Sticks produce a soft glow that will last for up to 8 hours. Great fun at parties and niteclubs. The chemicals are non-toxic and non-flammable.
•5 colours available.
•Size 150 (L) x 18 (D) mm.
Cat. ST-3160 Red
Cat. ST-3161 Yellow
Cat. ST-3162 White
Cat. ST-3163 Blue
Cat. ST-3164 Pink
$2.50 each

5 Input Stereo DJ Mixer

Mix and fade in style at your next party with this full-feature mixer. AC plugpack included. See cat. page 224 for full details. Cat. AM-4200
$119

PAR 36 Can Light

Includes mounting, bracket and 240V-6V transformer. Globe not included. Use our SL-2964. See cat. Page 251.
Cat. SL-2960
$37.95

Colour Wheel for PAR36

This translucent colour wheel attaches to our PAR36 spotlight and changes colours as the 240V motor rotates the 4 colour segmented wheel. Diameter 230mm, motor dia. 75mm. 600mm long power cable included.
Cat. SL-2961
$31.50

'Ice' Ropelight

A brilliant translucent effect of lights under ice. 4-colours combine for 8 different fading and chasing effects. A quality product with very long globe life. 240V operated.
Cat. SL-2820
$68.95

20" Neon "Lava" Lamp

12VDC powered, creating a flow of twisting multi-coloured light.
See cat. Page 252.
Cat. ST-3140
$83.95

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OVERNIGHT DELIVERY AVAILABLE

FREECALL FOR ORDERS 1800 022 888

12VDC/240VAC SMART BATTERY CHARGER
10xAA or AAA Ni-Cd & Ni-MH

This micro-processor controlled charger will accept a combination of up to 10 'AA' or 'AAA' batteries, and is suitable for both Ni-Cd and Ni-MH type cells. Processor uses delta V sensing to achieve maximum charge while individual LED indicators display charging status. Cat. MB-3612 **$69.95**

Buy a MB-3512 Smart Charger along with 6 high capacity 1500mAh Ni-MH 'AA' batteries this month in time for Christmas, and we will give you the remaining 4 FREE! SAVING - $15.20

Universal FAST Ni-Cad/Ni-MH Battery Charger/Discharger

$59.95

Automatically discharges the battery before switching to fast charge mode then finally to trickle charge. AA, AAA, C, D and 9V catered for. 9V batteries are not fast charged. See cat. Page 135 for details. Cat. MB-3500

MAINS SURGE AND PHONE LINE FILTERS

Telephone & Dual Mains Protection

Protect both your computer and modem or, of course, your fax and answering machines. Inexpensive insurance against voltage surges. Cat. MS-4028 **$29.95**

6 Way Power Outlet With Mains Filter

$36.95

Includes safety circuit breaker, spike protection, voltage surge protection and noise rejection filter network. 10A rated and fully approved. Cat. MS-4030

FAST AA/AAA Ni-MH Battery Charger

Why wait overnight for your batteries to recharge? Approximate 5hr charge time then auto-switch to trickle charge. Plugs directly into 240V mains outlet. Cat. MB-3509 **$39.95**

In a Hurry? Fast Charge!

Miniature Battery Charger AA Ni-Cad & Ni-MH

Tiny and convenient! A small time charge chart is printed on the rear of the charger to determine correct charge rates. Will charge 2 or 4 batteries at a time. Cat. MB-3530 **$18.95**

Ni-MH Rechargeable Batteries

Ni-MH offer better performance than Ni-CADs. Benefits include no memory effect, higher current capacity and high-drain performance. See cat. P130 for full details.

AAA Size	650mAh Cat. SB-2444	**$3.59**
AA Size	1000mAh cat. SB-2459	**$3.35**
	1500mAh Cat. SB-2442	**$3.80**
C Size	4800mAh Cat. SB2448	**$14.95**
D Size	8000mAh Cat. SB2449	**$24.90**
9 Volt (8.4V)	150mAh Cat. SB2469	**$19.95**

WE CARRY A HUGE RANGE OF SOLDER TAG RECHARGEABLE BATTERIES FOR MAKING BATTERY PACKS

Mains Surge Protection

A simple yet effective way to protect single devices against surges and general mains noise. See cat. Page 123 for full specs. Cat. MS-4008 **$14.95**

Telephone & Mains Protection

Similar to above protector but with a single mains outlet instead of two. See cat. Page 123 for specs. Cat. MS-4026 **$22.95**

Jaycar will match or better the price of any product our competitors sell, provided the goods are in stock, and of the same quality. Sale Prices included.

6 Way Power Outlet With Mains Filter & Phone Protection

$39.95

Incorporates the protection features of our MS-4030 model a well as telephone/data line protection sockets. The ideal board for computer, printer, scanner, multimedia speaker and modem protection. Cat. MS-4036

How many battery dependant devices do YOU have?

Stop wasting money on everyday batteries. Switch to rechargeables & SAVE!

- TV & VCR Remote Controls
- Portable CD Player
- Gameboy
- Telephone Caller ID Unit
- Digital Camera
- Palmtop Computer
- DVD Remote Control
- Remote Control Car
- Wireless Doorbell
- Alarm Clock

AUTO SLA BATTERY CHARGER 2/6/12V

This fully automatic lead acid battery charger is suitable for 2, 6, and 12V sealed acid batteries.
- 600mA charging current
- Short Circuit Protection
- Wrong Polarity Protection
- Constant Charging Current
- LED status indicator

Cat. MB-3518 **Was $42.95 $32.95**

DON'T LET YOUR HOLIDAY MEMORIES FADE AWAY!

Lithium Camera Batteries

Photo 1	Cat. SB-2400	**$9.95**
Photo 2	Cat. SB-2401	**$15.95**
Photo 3	Cat. SB-2404	**$9.95**
Photo 4	Cat. SB-2402	**$15.95**

CONVERT THIS... TO THIS...

240VAC - 110VAC VOLTAGE CONVERTERS

Electrically Isolated Transformers

These are recommended for medically related application or when operation is required near water or high moisture environments. See cat. page 121 for full specs.

120W Isolated	Cat. MF1080	**$99.95**
250W Isolated	Cat. MF1082	**$129**
500W Isolated	Cat. MF1084	**$219**

100W Standard
Includes overheat protection. Suited to low power consumption devices. Not dielectrically isolated. Cat. MF1091 **$49.95**

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OVERNIGHT DELIVERY AVAILABLE

Wall Mount Step Light
Will mount on a wall so it's great for step or path lighting. Points down so no glare. Suits JC pin globe. Cat SL-2778

$16.75

Garden Flood Light
Includes spike for pushing into the ground. Length 310mm incl spike. Suits MR16 globe. Cat. SL-2770

$22.50

PRO-GRADE OUTDOOR GARDEN LIGHTING

Produce brilliant lighting effects like this!

Flushmount Illumination
Designed to be embedded into a path or walkway. Can be walked on. Suits MR16 globe. Cat. SL-2776

$22.50

Focal Spotlight / Highlighter
Feature a palm or shrub with a narrow-beam halogen. Spike and hood included. Length 320mm approx. Suits MR16 globe. Cat. SL-2772

$22.50

Pathway Illuminator
Stylish design for pathways. Used at regular intervals, the effect is spectacular. Suits MR16 globe. Cat. SL-2780

$22.50

Pagoda
Light up the path as well as the surrounding garden. Suits JC pin globe. Cat. SL-2784

$22.50

General Purpose Spotlight / Highlighter
Bracket mounting for fences or tree trunks. Spike incl for ground mounting. Suits MR16 globe. Cat. SL-2774

$22.50

Globes not supplied Available separately.

SAVE ON GARDEN LIGHTING TRANSFORMERS
See cat. page 255 for our complete range of indoor/outdoor transformers.

240VAC to 12VAC

105W Indoor
Will power 2 x 50W halogens or 5 x 20W. Ideal for pathway lights. Cat. MP-3043

WAS $39.95
XMAS $29.95
SAVE $10

240VAC to 12VAC 150W Outdoor
Dust and waterproof; suitable for mounting outside away from direct rain. Cat. MP-3048

WAS $69.95
XMAS $59.95
SAVE $10

240VAC to 24VAC

150W Indoor
Delivers enough to run 3 x 50W or 5 x 20W and 1 x 50W or 7 x 20W. 24V is more suited to long cable runs. Cat. MP-3045

WAS $49.95
XMAS $39.95
SAVE $10

240VAC to 24VAC 150W Outdoor
Dust and waterproof; suitable for mounting outside away from direct rain. Cat MP3049

WAS $69.95
XMAS $59.95
SAVE $10

MR16 HALOGEN LAMPS
See cat. Page 256 for our complete range of halogen lamps.

12V Halogens 51mm 38° Cat. SL-2730 20W **$5.99** Cat. SL-2732 50W — $5.99

24V Halogen Cat. SL-2737 51mm 20W 38° — $7.95

12V 50W Coloured Halogen Lamps
Ideal for special feature lighting. 51mm diameter and 38° wide angle. Genuine glass lens. Cat. SL-2741 Red Cat. SL-2742 Green Cat. SL-2743 Blue Cat. SL-2744 Yellow

All one low price $6.95ea

VIDEO INTERCOM SYSTEM
NEW

FANTASTIC NEW LOW PRICE

Consists of a small external unit that houses a black & white CCD camera, speaker & microphone. Built in infrared illumination lets you see visitors both day and night. Internal unit houses the 4" monitor, handset and control buttons. Doubles as a doorbell. When your visitor presses the button the bell sounds and the monitor switches on and you can talk to the caller. You can then even unlock the door remotely with our optional electric door strike (Cat LA-5078). Includes a 10m cable and plug pack power supply. Cat. QC-3412

Used to sell for $489 $299.50ea

Wireless Doorbell with Strobe Light
Not your average door bell! The receiver is able to identify 3 different Door Button Transmitters (Cat. LA-5015). Handy if you have more than one entrance to your home or property. You can even have multiple receivers. Have the doorbell sound a chime or flash a strobe, or both. Approximate 50mtr range (over 60% more than inferior units) Door button not included. Cat. LA-5015

WAS $59.95
SAVE $10

XMAS $49.95

Doorbell Button For LA-5015 Battery included. $24.95 Cat. LA-5016

Plasma Tube
Over half a metre tall! Create interesting effects in your living room! See cat page 255 for details. Cat. SL2971

$99

ENTERTAINING OUTSIDE THIS SUMMER?
DRESS UP YOUR BACKYARD OR PERGOLA WITH THESE ATTRACTIVE LIGHTING PRODUCTS

Low Voltage Garden Lighting

$1.75m

12V operated and supplied on a continuous 100mtr roll – simply use what you need. 3 bulbs per metre. These look sensational in trees, around the pergola, lattice fencing, etc. Cat. SL-2810

2001 Cat price $2.20/m

COLOUR CAPS, REPLACEMENT GLOBES & REFLECTOR CAPS AVAILABLE. SEE CAT P257.

'Twinkle' Lights
Produce shimmering colour fading and other enchanting patterns along a 5-metre length of bundled, bonded globes. Indoor, or outside undercover use only. *Two versions available:

Gold or Multi-Colour (red, green, yellow & blue). Be the envy of your friends and neighbours this summer! Mains powered.

MULTI-COLOUR Cat. SL-2832
CANDLELIGHT GOLD Cat. SL-2830

$45.95ea

DUMMY VIDEO CAMERA Cat. LA-5316

$32.95

FAKE ALARM Cat. LA-5130

$47.50

Wireless CCD B&W Camera & Monitor
An excellent surveillance system that sets-up in minutes! Infrared LEDs for night monitoring and audio transmission both standard features. Excellent performance 100M line of sight range. See cat. Page 197 for full details & power requirements. Cat. QC-3450

XMAS PRICE $329
WAS $359 SAVE $30

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OVERNIGHT DELIVERY AVAILABLE

FREECALL FOR ORDERS 1800 022 888

100 Watt (200W Surge) 12VDC to 230VAC Electrically Isolated Inverter

NEW

Isolated for increased safety. The perfect portable power solution. Ideal for small TVs, VCRs, laptops and battery chargers, etc. See cat. page 124. Cat. MI-5058

$89.50

140 Watt (450W Surge) 12VDC to 230VAC Electrically Isolated Inverter

Isolated for increased safety. Suitable for fax machines, lamps & fluoros, laptops, etc. See cat. Page 124. Cat. MI-5060

$109.50

300 Watt (900W Surge) 12VDC to 230VAC Electrically Isolated Inverter

Isolated for increased safety. Suitable for larger colour TVs, recharge camcorder batteries, power spot lamps, etc. Cat. MI-5062

$129.50

400 Watt (1200W Surge) 12VDC to 230VAC Electrically Isolated Inverter

Isolated for increased safety. 20" colour TVs, 100W halogen worklights, electric fans, etc. Cat. MI-5064

$199.50

Camping Shower

Whether you're into camping, boating or 4-wheel driving, you'll never have to 'rough it' again! Add a touch of luxury to your next trip away. All you need is a bucket of warm water and your vehicle's 12V battery (via cig lighter socket) and you can wash away the cares of the day. See cat P268 for details.

$31.95 Cat. YS-2800

3 LED + Bulb Head Lamp

The best of both worlds – selectable between high brightness, localised LED light and wider-angle incandescent light. 'O' ring seals are featured to improve water resistance. Entire product weighs less than 135g including the 3 x AA batteries, which are included. Great for all types of night work as well as fishing, camping and hiking. Cat. ST-3070

$39.95

Super-Bright 1 LED "White" Head Torch

Batteries can last up to 80 hours due to the incredible low power drain of LEDs. Exceptional light output from such a small device. Can be worn as a headlamp or clipped onto your shirt, belt or hat, etc.. Uses 3 AAA batteries – supplied.

$19.95 Cat. ST-3057

BIG 12V SPOTLIGHT

Powered straight from your car or boat's cigarette lighter socket to produce light output as bright as a car's headlight on high beam!!! Lightweight and solid ABS construction featuring a lock-on power trigger and hanging clip for convenient storage. Power lead 2 in length, lens 153mm diameter. Cat. ST-3027

$22.95

500,000 CANDLE POWER RECHARGABLE SPOTLIGHT

Mega-serious halogen light output. Operates from a removable 6V 4AH SLA battery (included) and supplied with a 240V charging plugpack as well as a lead to charge from your car's cigarette lighter socket. Trigger lock allows for hands free operation with up to 20 mins continuous use. Beware of inferior quality units which don't allow battery removal. Cat. ST-3030

$39.95

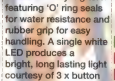
Mega-Bright 3 LED "White" LED Head Torch

Perfect for camping, bush walks at night, crawling inside the roof or under the house, map reading, etc. Headband included or clip onto clothing for handsfree work. 3 x AAA batteries included. Weighs just 62g with batteries! Cat. ST-3058

$29.95

Robust Super Bright LED Keyring Torch

Aluminium keyring torch featuring 'O' ring seals for water resistance and rubber grip for easy handling. A single white LED produces a bright, long lasting light courtesy of 3 x button cells (included). Cat. ST-3072



$19.95

Super Bright Rechargeable 6V halogen Torch

Uses a highly efficient halogen lamp to produce a bright beam that will last up to 2 hours. Includes an adjustable stand for hands-free use as well as a shoulder strap and mains adaptor for charging. Cat. ST-3086

$47.95

Mini Waterproof Camping Lantern

Will float if accidentally dropped into water! Features a bright Krypton globe and has a lens diffuser for improved illumination. Just the shot for boating, fishing, sailing, camping or as an emergency light around the house. 4 x AA batteries required – not included. •160mm tall Cat. ST-3033

$13.95

Waterproof Camping Table Lantern

Features a bright 5W fluoro tube that produces almost as much light as a 60W globe! 190mm high x 130mm diameter, powered by 4 x C batteries - not included. Cat. ST-3035

$22.95

Laser Safety Light Be Seen Be Safe!

Primarily a bike safety light but can be used for all sorts of activities. Uses 5 very bright 1000MCD LEDs which are visible up to 800 metres. Also features 6 display functions. Requires 2 x AAA batteries (not included). Cat. ST3038

$9.95

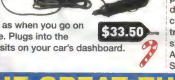
4 x AA Solar Ni-Cad Battery Charger

Ideal for recharging batteries while camping, yachting or anywhere 240V is unavailable. See cat. Page 140. Cat. MB3502

$15.95

Solar Car Battery Booster

This trickle charger saves your car's battery from going flat when your car is left idle for extended periods of time such as when you go on holidays, for example. Plugs into the cigarette lighter and sits on your car's dashboard. Cat. MB-3503



$33.50

SLA Carry Bag

Ideal for powering portable devices such as camcorders, video lights, tranceivers – even your favourite spotlight! Suits our 12V/7.2Ah & 6V/12AH SLA. Approx max size 161x65x101mm. See cat. page 130 for details. Cat. HB-6360

$18.95

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OVERNIGHT DELIVERY AVAILABLE

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1800 022 888
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SAMSUNG DIGITAL VOICE RECORDER

This incredible recorder will store up to 810 min. (yes! That's 13.5 hours!) of voice quality audio. 4 separate message groups are available and each group can have up to 100 messages. Too many features to list here – refer to our previous flyer or our web site. Cat. XC-0280

Save $30 Xmas Price $419.95

2.4Ghz Wireless A/V Transmitter With I/R Extender

$239

A powerful 10mW signal enables you to enjoy crystal clear reception of cable TV in a room away from the cable TV set top box! You can even use your cable TV remote control in another room as this unit includes a wireless repeater! Each unit comes complete with stereo audio and video transmitter and receiver, including AC power pack supplies. A special 6-way DIP switch is included to avoid interference with other units. Can also be used with VCR's, DVD, VCD, and CD players. Cat. AR-1806

See Cat. page 220 for details

150 Watt RMS 12" Powered Sub

Add this high performance 'subby' to your home cinema system for those far off rumbles and some serious DVD action! See cat. P216 for full specs. Cat. CS-2456

$499

4 Door Central Locking Kit For Cars

Add a touch of luxury to your car with this high quality locking kit. Beware of cheaper, inferior units available elsewhere. Supplied with hardware & wiring loom. See cat. P184 for full info. Cat. LR-8830

$59.95

2 Door Central Locking Kit For Cars

Supplied with one master and one slave solenoid driver plus hardware and wiring loom. Cat. LR-8838

$39.95

Keyring Laser Pointer

Chrome plated with keyring attached. Legal max output of <1mW. Very small size, only 73mm long. Cat. ST-3102

Very small

$12.95

Instant Digital Tape Measure

ULTRASONIC DIMENSION PRO

Provides an instantaneous and easy means of measuring room dimensions up to 12.5 metres. Measuring point is marked by red laser dot. Ideal for painters and renovators to produce a rough quotation in seconds. See cat P264 for details. Cat. QM-1620

Xmas $49.95 Save $20

Remote Control For Central Door Locking

$79.95

Unlock your car on those wet and windy days with just the press of a button. Supplied with 2 stylish transmitters. Cat. LR-8831

Super Bright LED Keyring Torches

So good that everyone in the office bought one! An incredible light output that will amaze your friends. Measure just 45(L)x32(W)x15(D)mm! A great gift for Christmas.

Cat. ST-3044 Red	$9.95
Cat. ST-3046 Yellow	$9.95
Cat. ST-3047 Blue	$14.95
Cat. ST-3048 White	$14.95
Cat. ST-3049 Green	$14.95

SEE PAGE 1 FOR OUR UV VERSION

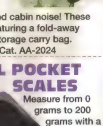
Blue 12" Twin Neon Highlight

Produces an enchanting BLUE NEON GLOW

$75.95

These fascinating tubes will add a touch of class to all sorts of places. Terrific as highlights for show vehicles or unique ornament at home. 12VDC powered. 235mm length and 10mm diameter. Cat. ST-3134

Noise Cancelling Headphones



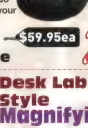
$59.95

Save $20

Hi-tech circuitry to reduce background noise by as much as 12dB. Great for that next plane trip – not only will you hear all the in-flight entertainment, you'll probably sleep better by reduced cabin noise! These are high quality headphones featuring a fold-away design and supplied with soft storage carry bag. Save $20 on catalogue price. Cat. AA-2024

B&W CMOS Cameras with Audio

NEW



These cameras are low cost enough to mount at your front door to check on visitors, monitoring the kid's play room, keeping an eye on a sleeping child, or mount near a window to monitor the pool. Measures 32 x 32mm, available in two styles of lens. Composite video output provided for A/V input on your TV or VCR. 12VDC required. Cat. QC-3441 Standard Lens Cat. QC-3442 Pinhole Lens

$59.95ea

Both one low price

CD-ROM CATALOGUE

- Over 4,700 Products
- Printable Order Form
- Direct Email Ordering
- Comprehensive Searching

Cat. BJ-5005 $2.50

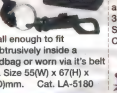
DIGITAL POCKET SCALES

Measure from 0 grams to 200 grams with a resolution of 0.1 grams and are compact enough to be carried in a shirt pocket. Measures only 120Lx78Wx22Dmm Supplied with protective cover. See cat P111 for details. Cat. QM-7246

X'mas $149

Was $199 Save A Whopping $50

Personal Alarm



Emits an unbearable screech that is impossible to ignore.

$9.95

Small enough to fit unobtrusively inside a handbag or worn via it's belt clip. Size 55(W) x 67(H) x 20(D)mm. Cat. LA-5180

Desk Lab Style Magnifying Lamp

Features a 110mm diameter lens and quality steel cantilever arm and 22W fluoro lamp. Weighs a healthy 3kgs for increased stability. See cat. Page 261 for info. Cat. QM-3522

$149

LCD Blue EL Backlit Thermometer and Clock

We've seen similar clocks in trendy lifestyle stores for twice the price! Press the soft-touch clear cover to illuminate the display, giving the clock it's own unique look and feel. •Batteries supplied. •117(H) x 90(W) x 62(D)mm. Cat. XC-0226

$39.95

GREAT GREAT GREAT GREAT GREAT

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ZONE ZONE ZONE ZONE ZONE ZONE Z

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DELIVERY AVAILABLE

OVERNIGHT

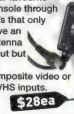
Auto Ranging DMM

Accurate, simple to use meter that features relative measurements, capacitance, frequency and diode test functions. See cat. page 27 for details. QM-1535 **$39.95**

Wireless Computer Mouse

Discard annoying mouse cables for good! Features 2 scroll wheels, superior 520dpi resolution and 'sleep' mode to conserve battery power. See cat. page 159 for info. Cat. XM-5118 **$39.95**

VIDEO GAME RF MODULATORS



Allows you to play your favourite console through TV's that only have an antenna input but no composite video or S-VHS inputs. **$28ea**

Playstation Cat. LM-3874
Nintendo 64 Cat. LM-3876
Dreamcast Cat. LM-3875

Programmable LCD Soldering Station

One of the best stations we've seen in years! Precise temperature control and 3 user-preset temperatures are just two features of this German designed soldering station. Refer to cat. P41 for all the features of this fabulous product. Cat. TS-1400 NEW **$249**

STORAGE CASES

These plastic cabinets are designed to hold all your components such as resistors, semis, caps, etc. 3 sizes available. See page 290 for complete details.

16 Drawer Cat. HB-6319 $9.95
30 Drawer Cat. HB-6320 $18.95
33 Drawer Cat. HB-6321 $26.95

Solder Stand

Every hobbyist and technician needs one of these on their workbench! Features super-heavy base for stability. Size 90(W) x 100(L) x 110(H). Cat. TS-1504 **$14.95**

25W 240V Soldering Iron

Features a stainless steel barrel and cool-grip handle. Ideal for the hobbyist or handperson. Cat. TS-1465 **$19.80**

Regulated Variable Lab Supply 0-30VDC / 0-3A

A superb PSU featuring 5V and 12V fixed rails, an well designed, uncluttered, front panel and LEDs to indicate constant current and constant voltage modes. See cat. P118. Cat. MP-3084 **$229**

Jumbo LCD Clock Module

Build this excellent clock into your own enclosure. Features thermometer, voice announcement, melody chime and am/pm indicator. 12/24hr and C/F temperature selectable. Runs on just 2 AA batteries – use our SB-2424. **$39.95**

•145(H) x 180(W) x 18(D). Cat. XC-0127

Phone / Fax / Modem Extension System NEW

This " Easy Jack" phone extension product turns any power point in your home or office into an extra phone line extension. Works with standard wired phones, c/-less phones, answering machines and even PC modems. There's no wiring, no drilling – just plug it into any mains outlet to create an instant phone line extension. Cat. YT-7020 **$195**

DON'T TOLERATE UNSIGHTLY GRAFFITI ON YOUR PROPERTY!

Graffiti Remover Gel NEW

This is a high viscosity gelled product that clings to vertical surfaces and removes graffiti from porous and semi-porous surfaces such as brick and wood. Removes marks made by felt pens, most paints, crayon, lipstick, etc. Harmless to most plastics and metal. Supplied in a 400ml/310g aerosol can. Cat. NA-1402 **$28.95**

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03-01

Last month, we introduced our new high-performance stereo amplifier and described the circuit details. This month, we begin the construction by showing you how to build the preamp, RCA input & power amplifier modules. The full performance details are also provided.

Building the Ultra-LD 2 x 100W Stereo Amplifier

ALTHOUGH THERE'S A LOT of work in building this new amplifier, it's really all quite straightforward. Most of the work involves assembling the six PC board modules but there's also a fair bit of wiring do be done. Make no mistake – this project will gobble up quite a few man-hours and is no job for the faint-hearted.

To make the job as easy as possible, Altronics in Perth will be offering complete kits for this new high-performance amplifier and these are expected to be available by the end of December.

The Altronics kit will come with a professional rack-mounting case that's been custom-made for the job. The case is powder-coated, all the holes are pre-drilled and the front and rear panels are supplied with screened lettering. In short, there's absolutely no metalworking to do.

Note that although our prototype shows rack-mounting flanges and handles, the Altronics metalwork will give you the option of leaving these items off, if that is what you prefer. These parts will still be supplied with the metalwork – it's up to you to decide whether or not to use them.

The detachable front panel really looks the part. The top and bottom edges are curved to improve the appearance and the design is "relieved" by the vertical slots at either end and the slots running horizontally along the bottom. And in case you're wondering how the front panel is secured on the prototype, it's mounted on spacers on the front of the chassis and is fastened at either end by screws that pass through the front of the chassis and into the handles at either end.

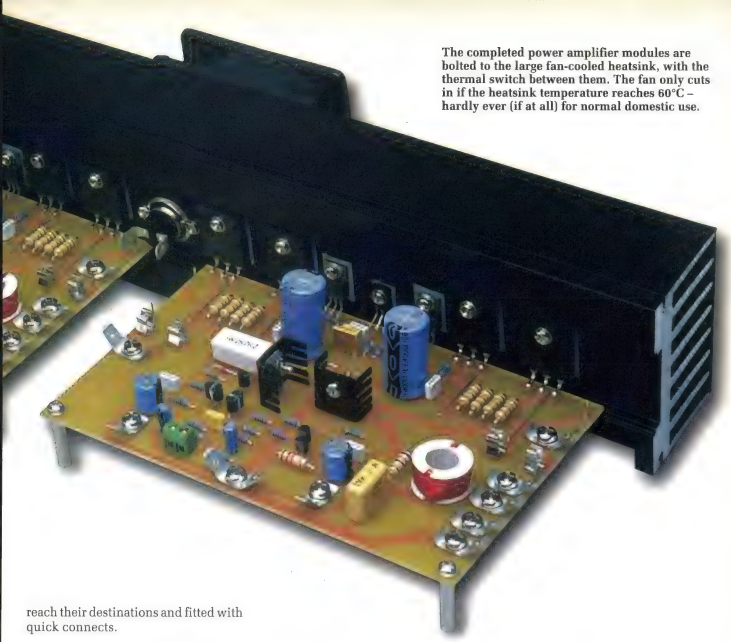
This means that no screw heads are visible on the front panel.

Alternatively, if you choose not to use the handles, the front panel can be secured using the attractive Allen Key screws supplied with the kit.

Inside, the large fan-cooled heatsink is supplied drilled and tapped, and has the necessary channels milled into its base to allow the wiring to run between the front and rear sections of the case. The power supply heatsink is also supplied cut to size and pre-drilled.

Other highlights of the Altronics kit include fibreglass PC boards with solder-masked tracks, gold-plated heavy-duty loudspeaker terminals, gold-plated RCA input connectors and a custom-made power-transformer with all leads made the correct length to

Part 2: By GREG SWAIN & LEO SIMPSON



The completed power amplifier modules are bolted to the large fan-cooled heatsink, with the thermal switch between them. The fan only cuts in if the heatsink temperature reaches 60°C – hardly ever (if at all) for normal domestic use.

reach their destinations and fitted with quick connects.

Preparing the quick connects

All the male quick connects supplied in the kit are double ended but most locations require a single-ended connector. Therefore, the first job is to convert 48 of the male quick connects to single-ended connectors by cutting off one of the lugs. This can be done using a sharp pair of tinsnips – the quick connects are made of brass and are quite easy to cut.

Clean the sharp edges up using a light file after cutting off each lug.

Semiconductor numbers

Before starting the board assemblies, it's important to note that some of the transistor, LED, diode and regulator numbers shown on the circuits (and overlays) are duplicated across the various modules. That's because most of the circuitry is based on previously published designs and we've retained the original numbering schemes.

For this reason, always be sure to check the relevant circuit or section of the parts list for that module when looking up the type numbers for the semiconductors.

Building The Preamplifier & LED Display Module

Fig.6 shows how to build the Preamplifier & LED Display Module.

You can start the assembly by installing the wire links, resistors and diodes, taking care to ensure that the latter are correctly oriented. Table 1 shows the resistor colour codes but it's always a good idea to check each value using a digital multimeter, as some of the colours can be difficult to decipher. Note that the two 150Ω resistors near rotary switch S1 have RF suppression beads slipped over one of their leads before they are installed on the board.

Once these parts are in, you can fit the five ICs and the two 3-terminal regulators (REG1 & REG2). ICs can be static sensitive, so always touch a grounded object before handling them and try not to touch any of the pins. This particularly applies to the NE-5534A devices (IC1 & IC3).

Note that IC1 & IC3 can be labelled either NE5534AN or NE5534AP. The "A" in the suffix designates a very low noise device. Don't use devices without an "A" in the type number (eg, NE5534N), as these have inferior noise performance.

Regulators REG1 & REG2 are mounted flat against the PC board and are secured using 10mm x M3 screws, nuts and star washers. This means

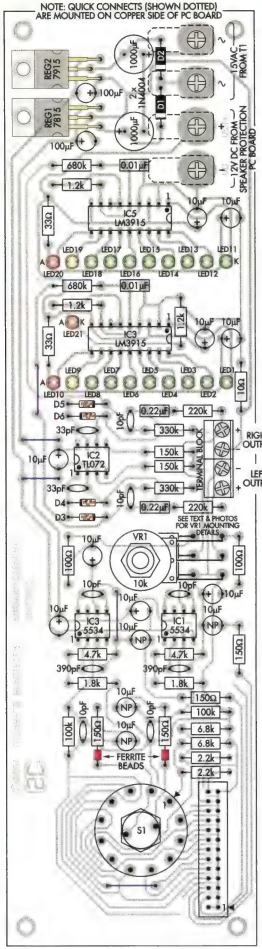


Fig.6: install the parts on the Preamplifier & LED Display board as shown here. Note that potentiometer VR1 and the LEDs must be stood off the board – see text and photos.

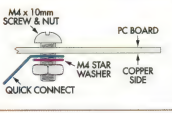


Fig.7: this diagram shows how the male quick connects are installed on the back of the preamplifier PC board.

Left: bend the leads of the 10µF electrolytic capacitors using needle-nose pliers, before installing them on the PC board (Note: some brands are supplied with the leads preformed).

that you have to bend their leads down by 90° before installing them on the board.

This is best done by slipping an M3 screw through the device tab, positioning it on the board and then gripping one of the leads with a pair of needle-nose pliers just before it reaches its mounting hole. The device is then lifted clear of the board and the lead bent at right angles, after which the procedure is repeated for the next lead.

The four quick connect terminals can be installed next. Unlike the quick connects on other boards, these are installed on the copper side of the Preamplifier PC board and are each secured using an M4 x 10mm machine screw, a star washer and a nut. Fig.7 shows the details.

Do up the nuts tightly so that the star washers bite into the quick connects. This should be done using a Phillips-head screwdriver on one side and a 4mm socket or nutdriver on the other. It's also necessary to get things nice and tight so that the quick connects cannot twist on the board.

The capacitors can be now be installed. You can install the four 10µF non-polarised (NP or BP) capacitors either way around but make sure that the polarised electrolytics are correctly oriented. The two 100µF capacitors near REG1 & REG2 should be mounted about 5mm proud of the PC board, so that their bodies clear the regulator leads.

Don't push the 10µF electrolytic capacitors too far down onto the board – applying undue stress to the capacitor leads can damage the internal connections. Instead, the bodies of these

Above: take care to ensure that switch S1 is correctly oriented when installing it on the Preamplifier board. Pins 2 & 3 must be towards the bottom – see Fig.6.

capacitors should sit 2-3mm above the board.

A better scheme is to preform the capacitor leads before fitting them, so that they drop straight in the holes (note: some capacitor brands are supplied like this). You can do this using a pair of needle-nose pliers – see photo.

The next step is to fit the two terminal blocks, followed by the 26-way pin header (ie, 2 x 13 pins). This item will probably be supplied as a 2 x 40-pin header but it's easily cut to size using a sharp hobby knife. You will need to cut two sections – one for the preamplifier board and one for the RCA input board.

A fine-tipped soldering iron and a good light are necessary when installing the pin headers, as the pins are quite close together and some have tracks running between them. If you have a magnifying lamp, then so much the better. Take care to ensure that there are no shorts between the pins and any adjacent tracks.

By the way, you will notice that many of the tracks around the pin header and rotary switch S1 are not connected at one end. These are earth "guard" tracks and are included to improve the channel separation and to reduce interference from unused signal sources.

Don't join any of these earth tracks together. You could get an earth loop if you do.

Now for the rotary switch. Cut its shaft length to 23mm using a small hacksaw, then install it on the PC board with pin 1 positioned exactly as shown on Fig.6 (ie, pins 2 & 3 mount closest to the pin header). Make sure that the switch has been pushed all the way down and is correctly seated against the PC board before soldering any of its pins.

It's a good idea to solder two diametrically opposite pins first, then check that the switch is properly seated before soldering the remaining pins.

Once the switch is in, rotate the shaft fully anti-clockwise, remove its locking nut and star washer, and move the indexing collar one position anti-clockwise (see photo). Finally, replace the star washer and mounting nut to lock the collar down.

The switch should now operate over five positions (instead of six), with the flat section of the shaft facing down for position 3.

This photo shows the male quick connects mounted on the prototype Preamplifier & LED Display board pictured last month. We fed the mounting screws through from the other side in the final version.

Installing VR1 & the LEDs

The LEDs must all be stood off the PC board so that they later protrude through their matching holes in the front panel when the PC board is mounted in the chassis.

This might seem awkward to arrange but it's really a snack. All you have to do is insert the LEDs into the PC board, then mount the board as shown in Fig.8, push the LEDs through their front panel holes and solder one lead for each LED. After that, it's just a matter of removing the board and soldering the remaining leads.

Make sure that the LEDs are all correctly oriented (the anode lead is the longer of the two) when installing them on the PC board.

Remove the front panel if necessary (by removing the handles) so that you can attach the nuts and spacers to the chassis. These should all be tight before mounting the Preamplifier PC board and soldering the LED leads.

Once the LEDs are in, you can install VR1 in similar fashion. This pot needs to have short lengths of tinned

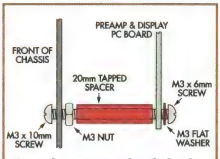


Fig.8: the mounting details for the Preamplifier & LED Display module. This module must be installed so that the LEDs and volume pot (VR1) can be pushed into position before soldering their leads – see text.

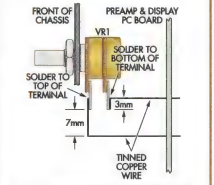


Fig.9: the mounting details for the volume control pot (VR1). Note particularly how the wire leads are attached to the pot terminals.

The volume pot (VR1) is mounted by first soldering tinned copper wire leads to its terminals. It is then loose-fitted to the PC board, the board mounted in the chassis and the pot fastened to the front of the chassis before soldering its leads.

Right: the source switch is changed from a 6-position type to a 5-position type by undoing the locking nut and moving its indexing collar.

copper wire soldered to its terminals so that it can be stood off the PC board – see photo. The pot itself is secured by mounting it on the front panel (the tinned copper leads simply make the connections back to the PC board).

Begin by straightening a 300mm length of tinned copper wire. This is done by clamping one end of the wire in a vyce and then stretching it slightly by pulling on the other end with a pair of pliers. Cut this wire into six 40mm lengths and bend three at right angles 10mm from one end and the other three at right angles 3mm from one end.

These six wires can now be soldered to the pot terminals as shown in Fig.9. Note that the wires with the 10mm sections solder to the top of their pot terminals, while those with the 3mm sections solder to the bottom of their terminals. Also, in the latter case, the right angle bend sits closest to the pot body.

You will need to devise some method of securing the pot while you attach the wires – eg, by lightly clamping it in a small vyce or by mounting it on some scrap aluminium.

The pot can now be installed by inserting the leads into the PC board, then mounting the board in the chassis and pushing the pot through its mounting hole. Check that the pot's anti-rotation spigot is correctly located in its hole before doing up the nut and soldering the leads at the back of the board.

The Preamplifier board can now be removed from the chassis and placed to one side while you build the other modules.

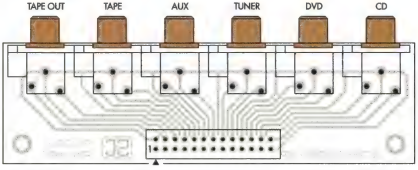


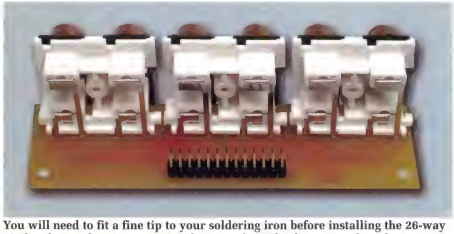
Fig.10: the RCA Input Module carries the three RCA 2 x 2 stereo socket pairs and a 26-way pin header. Snip the plastic locking "tangs" off the socket pairs before installing them on the PC board.

RCA Input Module Assembly

This one's a snack, since the board carries just three RCA 2 x 2 stereo socket pairs and a 26-way pin header – see Fig.10.

The first step is remove the plastic locking tangs on the RCA socket pairs using a pair of sidecutters. This done, fit the RCA sockets to the board and check that their plastic bodies are flush with the edge of the PC board. If the board protrudes slightly, remove the sockets and file the board down until it is "spot on".

The RCA sockets pairs can now be soldered in place, taking care to ensure that they are all seated correctly. Finally, complete this board assembly by soldering in the 26-way pin header.



You will need to fit a fine tip to your soldering iron before installing the 26-way pin header, as the pins are quite close together. Check your work under a magnifying glass when finished, to make sure that are no solder bridges between adjacent pads or tracks.

Power Amplifier Module Assembly

Now let's build the Power Amplifier modules. Fig.11 shows the assembly details.

Begin each board assembly by installing the wire links, resistors and capacitors but don't install the two 1000µF electrolytic capacitors at this stage. You can then install the 3.3V zener diode (ZD1), the fuse clips and the four PC stakes which terminate the 220Ω 5W test resistor leads (note:

these resistors are only installed temporarily when adjusting the quiescent current).

Make sure that the electrolytic capacitors and the 3.3V zener diode are installed with the correct polarity.

Note that the 1W resistors should all be mounted about 1mm proud of the board, to allow the air to circulate beneath them for cooling. The easiest way to do this is to use a strip of cardboard (about 14mm wide and 1mm thick) as a spacer. You just push the resistor body all the way down onto the cardboard, then slide the cardboard back out after soldering the leads – see photo.

The same technique can be used for mounting the 2.7kΩ 5W resistor, which should sit about 2mm above the board surface.

If the amplifier is intended for continuous high-power delivery at frequencies above 10kHz, then the 6.8Ω resistor in the output filter should be a wirewound type with a rating of at least 5W, otherwise it may burn out. The 1W resistor specified will be perfectly adequate for normal domestic situations.

When installing the fuse clips, note that they each have little lugs on one end which stop the fuse from moving. If you install the clips the wrong way, you will not be able to fit the fuses.

Next, mount the small-signal transistors; ie, BC546, BC556, BF469 and BF470 (Q1-Q9). These should be pushed down onto the PC board as far as they will comfortably go before soldering their leads.

Transistor pairs Q1 & Q2 and Q5 & Q6 are mounted with their flat faces touching each other, to ensure thermal tracking. Install one transistor of each pair first, then smear their faces with thermal grease before installing the other two transistors. The mounting holes have been carefully positioned on the PC board so that the flat faces of the transistor pairs touch each other when they are installed normally.

Transistors Q8 & Q9 must be fitted with U-shaped heatsinks before soldering them to the PC board – see Fig.11. The best way to go about this is to first fit each transistor in position and smear its mating surface with thermal grease, then loosely attach the heatsink using an M3 x 10mm screw, nut and star washer. This done, the assembly can then be pushed down until the heatsink contacts the PC board, the transistor leads soldered and the mounting screw tightened.

Note that insulating washers aren't required here, since the heatsink doesn't touch any other components.

Choke L1 is wound with 23.5 turns of 1mm enamelled copper wire on a 13mm plastic former. You can straighten the wire before winding on the turns by clamping one end in a vyce and then stretching it slightly by pulling on the other end with a pair of pliers.

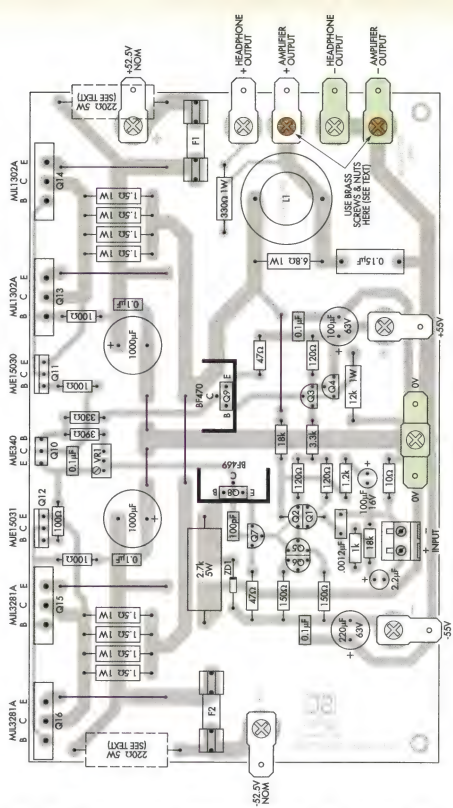


Fig.11: the parts layout for the Power Amplifier boards. Note that brass screws, nuts and star washers should be used to mount the quick connect terminals for the two loudspeaker outputs.

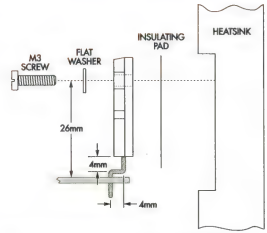


Fig.12(a): mounting details for the MJL3281A & MJL1302A output transistors.

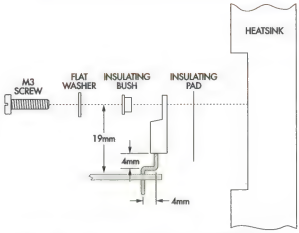


Fig.12(b): mounting details for the MJE15030 & MJL15031 driver transistors

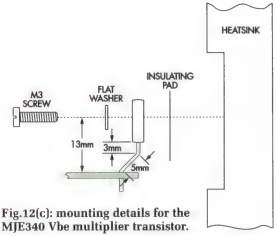


Fig.12(c): mounting details for the MJE340 Vbe multiplier transistor.

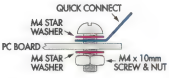


Fig.13: this diagram shows how the male quick connects are installed on the Power Amplifier, Power Supply and Loudspeaker Protection modules. Be sure to use brass screws, nuts and star washers where indicated on the parts layout diagrams.

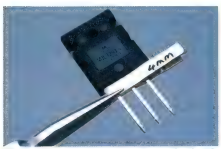
Bend one end of the wire at right angles (about 10mm from the end) and feed it through one of the end slots in the plastic former, then wind the turns on as neatly and evenly as possible. Finally, bend the free end of the wire through 90°, feed it out through the opposite slot and finish off with a few layers of insulation tape to hold everything in place.

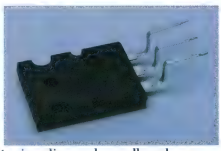
The individual coil leads can then be cleaned (by scraping away the enamel) and tinned before soldering the component in place.

You can now install trimpot VR1, the 2-way terminal block and the nine male quick connects. Fig.13 shows the mounting details for the quick connects – each is secured using an M4 x 10mm screw, two star washers and a nut.

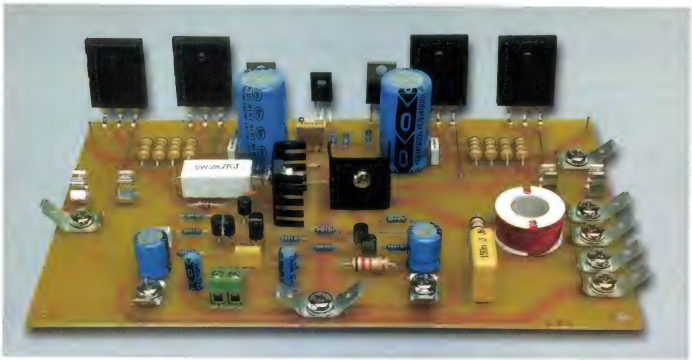
Note that brass screws, nuts and star washers are used to secure the quick connects for the loudspeaker output terminals. The reason for this is explained in the section where we detail the performance.

Do up the nuts tightly so that the star washers bite into the quick connects and the copper pads – and so that the quick connects cannot twist on the board. Note that a double-ended quick connect is used in the 0V posi-





These three photos show how the leads off the output and driver transistors are bent using pliers and a cardboard spacer, prior to installing them on the PC board. Make sure that the cardboard strip is cut exactly to 4mm before bending the leads at right angles – see also Fig.12 above.



This photo shows one of the completed Power Amplifier modules, prior to attaching it to the heatsink. Make sure that the mounting screws for the quick connect terminals are tight (use a screwdriver to stop the terminals from twisting while you do up the nuts with a socket).

tion. The other eight quick connects are all single-ended.

Heatsink transistors

OK, now for transistors Q10-Q16. These transistors are attached to a channel which runs across the centre of the heatsink. This makes it necessary to bend their leads as shown in Fig.12, before mounting them on the PC board.

Start by bending the leads for transistors Q11-Q16. As shown, the leads of each device must be bent at right angles away from the metal face, some 4mm from the plastic body. This done, the leads are then bent downwards by 90° a further 4mm away.

There's any easy way to do this and that's to use a strip of cardboard as a spacer. First, cut a strip of thin cardboard exactly 4mm wide, fold it in half and wrap it around the transistor leads so that it butts up against the plastic body. This done, you can then grip the leads right at the edge of the cardboard using needle-nose pliers and bend the leads up at right angles.

Finally, reposition the cardboard so that it butts against the bend before bending the leads down at right angles. The accompanying photographs show how it's all done.

Transistor Q10 (MJE340) has its leads bent as shown in Fig.12(c). By the way, don't bend any of the transistor leads right at the point where they narrow after emerging from the plastic body – it's all too easy to break the lead if you do.

Once all the leads have been bent, mount transistors Q13-Q16 in position by pushing them all the way down onto the PC board with their metal surfaces facing outwards. Solder one lead of each transistor initially, then test fit it on the heatsink before soldering the other leads.

If you haven't already done so, you will have to remove the heatsink to do this – it's held in the case by two self-tapping screws at either end and by a self-tapper underneath.

A strip of cardboard makes a handy spacer when installing the 1W resistors on the PC boards. Just push the resistors down onto the spacer and withdraw it after soldering the leads.

Once it's out, position the output transistors on the heatsink and install M3 x 10mm mounting screws to hold the board in position (don't worry about the silicone washers at this stage). Now inspect the underside of the board – the soldered joints and tracks should all clear of the heatsink channel by several millimetres. If the board fouls the heatsink, then the transistor leads have been bent incorrectly.

Assuming that everything is OK, the remaining leads can all be soldered and trimmed. Transistors Q10, Q11 & Q12 can then be installed on the board in similar fashion.

Once all the transistors have been installed, undo their mounting screws and fit each transistor with a thermal washer to isolate it from the heatsink. Transistors Q11 & Q12 also require insulating bushes to ensure isolation – see Fig.12(b).

Be sure to use a flat washer under each screw head and don't overtighten the mounting screws.

Now switch your multimeter to a high ohms range and check that there are no shorts between the heatsink screws and any of the transistor leads or metal tabs. If you do find a short, undo each transistor mounting screw until the short disappears. It is then a matter of locating the cause of the short and remounting the offending transistor.

Once everything is together, you can

continued on page 64

Fig.14: frequency response in both channels at 1W into 8Ω. It is about 0.3dB down at 20Hz and about 0.5dB down at 20kHz.

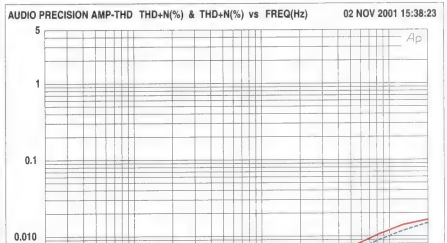


Fig.15: total harmonic distortion (THD) vs. frequency – both channels driven into 8Ω loads at 90W.

THE MAIN SPECIFICATIONS for the Ultra-LD 100W amplifier are shown in an accompanying panel but the graphs of Figs.14-17 give a more detailed picture.

Fig.14 shows the frequency response in both channels at 1W into 8Ω. It is about 0.3dB down at 20Hz and about 0.5dB down at 20kHz. Note that there are slight differences between the two channels.

As in the previous amplifier, we have deliberately curtailed the high frequency response beyond 20kHz. This is most important for low EMI (electromagnetic interference) susceptibility which means that signals from computers and video monitors are less likely to be a problem. Nor will the amplifier respond to extraneous signals such as 38kHz multiplex from stereo FM tuners or over-sampling artefacts from CD players or other digital program sources.

By the way, all of these performance graphs are for signals passing through both the preamplifier and amplifier stages. Therefore readers who have access to the previous series of articles on the Ultra-LD 100W amplifier in the March, May and August 2000 issues will notice that there are some differences in performance.

Specifically, because the audio signals now pass through more stages of amplification and because of the new amplifier's much more compact wiring layout, the distortion performance is not quite as good as the earlier, simpler design. Nevertheless, the performance is still pretty good and far better than the vast majority of commercial hifi amplifiers, many of which cost much more.

Fig.15 shows the total harmonic distortion in both channels at a power level of 90W into 8-ohm loads and with an input signal of 1.8V RMS for the frequency range from 20Hz to 20kHz. These curves are taken with a measurement bandwidth of 10Hz to 80kHz.

Fig.16 shows the total harmonic distortion on both channels at 1kHz over a range of powers from 500mW to well beyond clipping, with both channels driven simultaneously into 8-ohm loads. As can be seen, one channel clips (ie, overloads) at about 90W while the other clips at around 98W. Naturally, somewhat more power is delivered from both channels under normal program conditions. Measurement bandwidth is 10Hz to 22kHz.

As can be seen, for most powers at 1kHz, the total harmonic distortion is between .002% and .003%. The rise in the curve at lower powers is due to residual noise and is not due to an actual increase in distortion.

As mentioned in previous articles on this amplifier design, we do not recommend it for use with 4-ohm loudspeakers, as the distortion is quite a bit higher.

Signal-to-noise ratio is -103dB un-

weighted (20Hz to 20kHz) or -109dB A-weighted. This is taken at maximum sensitivity (ie, volume control fully clockwise) and is even better at normal settings. It is really very quiet.

Fig.17 shows the separation between channels and as you can see, it is just on -60dB over the whole frequency range from 20Hz to 20kHz, in both directions; ie, from left to right and from right to left and this applies for any source, at any normal program level or power output.

Finally, the damping factor is just over 100 for all frequencies below 1kHz, dropping to a bit over 60 at 10kHz. Again, these are very good figures.

Brass screws and nuts

In measuring the performance of the prototype amplifier we found that the initial distortion measurements were somewhat disappointing. While they were respectable, they were not quite as good as we were hoping for.

In order to track down the problem, we then decided to measure the harmonic distortion through the power amplifiers only. So we connected the Audio Precision input signals directly to the inputs of the amplifier modules and measured at the speaker output terminals at the rear of the case. Guess what? The distortion was still high; about twice what we have come to expect from these modules.

Eventually, we decided to measure the distortion right at the output of the amplifier modules themselves. What a revelation! Here the distortion was of the same magnitude as published in the original design last year. So what was happening?

To cut a long story short, the distortion arose from the various bolted "quick connect" spade lug connections from the amplifier and loudspeaker protection PC boards. We were using bright nickel-plated screws and bolts with plated brass "quick connect" spade lugs and each of these dissimilar metal joints were obviously non-linear; ie, the resistance across each joint varied with the current and this caused a small but significant increase in distortion.

Replacing all screws and nuts for the quick connects in the output signal path with brass equivalents eliminated those increases in distortion, giving a very worthwhile improvement in performance. These brass screw connections are shown in different colours on both the Power Amplifier modules and the Loudspeaker Protection board.

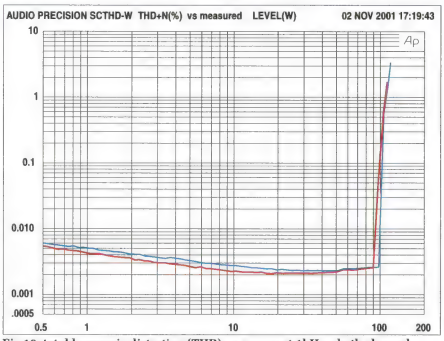


Fig.16: total harmonic distortion (THD) vs. power at 1kHz – both channels driven simultaneously into 8Ω loads.

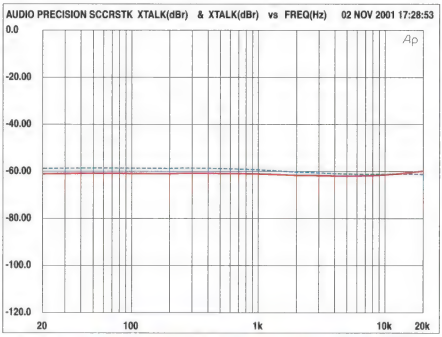


Fig.17: channel separation across the frequency range from 20Hz to 20kHz.

Specifications Of Prototype

Output power	100 watts per channel into 8-ohm loads
Frequency response	-0.3dB down at 20Hz; -0.5dB at 20kHz (see Fig.14)
Input sensitivity	0.5V RMS (for full power into 8Ω)
Harmonic distortion	see Fig.15 & Fig.16
Signal-to-noise ratio	-103dB unweighted (20Hz to 20kHz); -109dB A-weighted (with respect to 100W)
Damping factor	>100 at 100Hz and 1kHz; >60 at 10kHz
Stability	unconditional

Table 1: Resistor Colour Codes

Preamplifier & LED Display Module

No.	Value	4-Band Code (1%)	5-Band Code (1%)
2	680kΩ	blue grey yellow brown	blue grey black orange brown
2	330kΩ	orange orange yellow brown	orange orange black orange brown
2	220kΩ	red red yellow brown	red red black orange brown
2	150kΩ	brown green yellow brown	brown green black orange brown
2	100kΩ	brown black yellow brown	brown black black orange brown
2	6.8kΩ	blue grey red brown	blue grey black brown brown
2	4.7kΩ	yellow violet red brown	yellow violet black brown brown
2	2.2kΩ	red red red brown	red red black brown brown
2	1.8kΩ	brown grey red brown	brown grey black brown brown
3	1.2kΩ	brown red red brown	brown red black brown brown
4	150Ω	brown green brown brown	brown green black black brown
2	100Ω	brown black brown brown	brown black black black brown
2	33Ω	orange orange black brown	orange orange black gold brown
1	10Ω	brown black black brown	brown black black gold brown

Power Amplifier Modules

No.	Value	4-Band Code (1%)	5-Band Code (1%)
4	18kΩ	brown grey orange brown	brown grey black red brown
2	12kΩ	brown red orange brown	brown red black red brown
2	3.3kΩ	orange orange red brown	orange orange black brown brown
2	1.2kΩ	brown red red brown	brown red black brown brown
2	1kΩ	brown black red brown	brown black black brown brown
2	390Ω	orange white brown brown	orange white black black brown
4	330Ω	orange orange brown brown	orange orange black black brown
4	150Ω	brown green brown brown	brown green black black brown
6	120Ω	brown red brown brown	brown red black black brown
8	100Ω	brown black brown brown	brown black black black brown
4	47Ω	yellow violet black brown	yellow violet black gold brown
2	10Ω	brown black black brown	brown black black gold brown
2	6.8Ω	blue grey gold brown	blue grey black silver brown
16	1.5Ω	brown green gold brown	brown green black silver brown

install the two 1000µF 63VW electrolytic capacitors on the power amplifier module. There are two reasons why these aren't installed earlier on: (1) they're easily bumped and damaged; and (2) they make it awkward (but not impossible) to do up the mounting screws for Q11 & Q12.

The other power amplifier module can now be built and mounted on the heatsink in exactly the same fashion. Finally, complete the power amplifier assembly by attaching a 25mm tapped brass spacer to each of the front mounting hole positions.

Thermal cutout

There's just one more part to attach to the heatsink and that's the 60°C thermal switch for the heatsink fan.

Table 2: Capacitor Codes

Preamp & LED Display Module

Value	IEC Code	EIA Code
0.22µF	220n	224
.01µF	10n	103
390pF	390pF	390
33pF	33pF	33
10pF	10pF	10

Power Amplifier Modules

Value	IEC Code	EIA Code
0.15µF	150n	154
0.1µF	100n	104
.0012µF	12n	121
100pF	100pF	100

This is bolted to the centre of the heatsink, between the two power amplifier modules using two M3 x 10mm machine screws (see photo).

As supplied, the quick connect terminals on the thermal switch run parallel to its metal mating surface. These terminals should be bent back about 70° (to make them easier to access later on) using needle-nose pliers before bolting it to the heatsink.

Next month

That's all we have space for this month. Next month, we'll describe the assembly of the Power Supply and Loudspeaker Protector modules and give the wiring details. We'll also publish a complete parts list for those determined to start from scratch. **SC**

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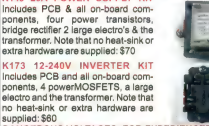

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20 x 2 LCD BACKLIT CHARACTER DISPLAY: Made by Optrex model #DMC2059, (data is available for similar 20 x 2 displays). 6mm x 8mm characters, 122mm wide x 30mm high. PCB dimensions 151mm wide x 56mm high. Uses standard Hitachi chipset (HD44780) with LED backlight (DL8) $11 each or 3 for $27

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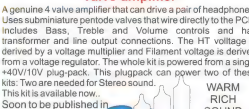
WARM RICH SOUND



Kit + plug pack (mono) $50
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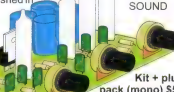

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GEARED STEPPER MOTORS... These Small geared stepper motors would be ideal for telescope tracking etc And include a 1350:1 Reduction

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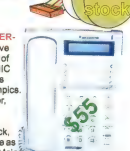


PARDY LITES

By Ross Tester

Having a party this festive season? Here's a light display which will really add to the occasion. It's easy to build, safe and adaptable to a wide range of hardware. It's not a chaser and it's not a colour organ. So what is it? Intriguing, that's what!

If you're looking for something to brighten up a Christmas or New Years party – literally brighten – this project could be right up your alley. It consists of four coloured 12V, 50W halogen globes which are driven in somewhat random patterns by the bass beat from your music. And if there's no music, it automatically switches over to its own random display.

You don't need to make any connection to your amplifier or speakers: an inbuilt microphone picks up the beat from any source of music, whether it be a stereo, karaoke, live band (but not a dead band), etc. Speaking of bands, if you're in one, this display will make your perfomance sparkle!

How do you mount the lights? That's really up to your ingenuity and your application. In our example, 12V halogen "downlights" are fitted pointing up (but at varying angles) into a squat wooden box about a metre long. The idea is to project the lights upwards against a white or pastel wall so that they throw patterns onto the wall.

In a semi-darkened room, á lá a typical party, the effect is rather spectacular . . . psychedelic seventies, even.

But if you don't like that display, there's nothing to stop you using the same basic circuitry to come up with whatever you wish. Want to make a "light box" – flashing lights inside an acrylic or Perspex-fronted box? No problem (in fact, you could get away with much lower wattage bulbs and therefore a cheaper transformer).

Maybe you want to light up something specific – again, no problem. Because the lights operate from a safe 12V, you don't have to be an electrician to install them. Gee, we just had a thought: most garden lights these days are 12V – now that would make an interesting garden!

Want more light? There's nothing to stop you adding MOSFETs and lamps in parallel, as long as your transformer and bridge rectifier are rated for it. But more on this anon.

Circuit operation

With the exception of the input microphone, sensitivity control, the lamps themselves and the power supply (transformer and bridge rectifier), all of the circuitry is assembled on one small PC board.

The circuit comprises four sections: the input audio signal processing, the sequence generator, the lamp drivers and the power supply.

The input signal processing section has a low frequency filter and an amplifier section based on IC1a and IC1b.

Audio signal is picked up by an electret microphone and is applied via a 1µF coupling capacitor to IC1b, an inverting preamp with a gain of 16.

The low-pass filter components (at the input to IC1b) set the cut-off frequency to around 200Hz so only low frequency components (bass) pass to the next stage, an inverting amplifer based on IC1a.

The gain of this amplifier depends on the setting of VR1, so this in effect becomes a sensitivity adjustment.

The quiescent (no signal) DC output from IC1a is approximately 4V. Under this condition, the inputs of the Schmitt NAND gate IC2a will be a logic 1 and the output of this gate will be a logic 0.

When an audio signal is applied, the output will vary up and down from the 4V quiescent voltage, going either more positive (to a maximum of 5V) or as low as zero for negative swings.

If the input voltage is sufficiently low, the input to the NAND gate will be a logic 0, giving a logic 1 at its output. In summary, no signal produces a logic 0 at the output of the NAND gate and negative signal swings at its input produce a logic 1.

When IC2a has a logic 1 at its output, the 0.1µF capacitor at pin 5 of IC2b quickly charges via the 1N4148 diode and 4.7kΩ resistor. This produces a logic 1 at this point, enabling the oscillator, formed by IC2b, the 220kΩ resistor and .01µF capacitor to run. Its frequency is approximately 1kHz.

The output from this oscillator is connected via a 1N4148 diode to the input of 7-stage ripple counter IC3, causing it to quickly count up, changing the states at its outputs as it does. The first four outputs of IC3 are used to drive a display comprising individual 12V halogen globes, via switching MOSFETS Q2-Q5.

The display uses 12V, 50W halogen "downlights" such as these coloured ones from Jaycar or ordinary (white) ones you colour yourself.

Under these conditions, each bass beat will produce a burst of 1kHz signal to clock the counter (IC3). The count at which it actually stops after each beat is random, thus producing a totally random display, updated by each bass beat.

The oscillator is only enabled during the short time the audio signal is negative, causing bursts of oscillation on each bass beat, giving a new light display on each beat.

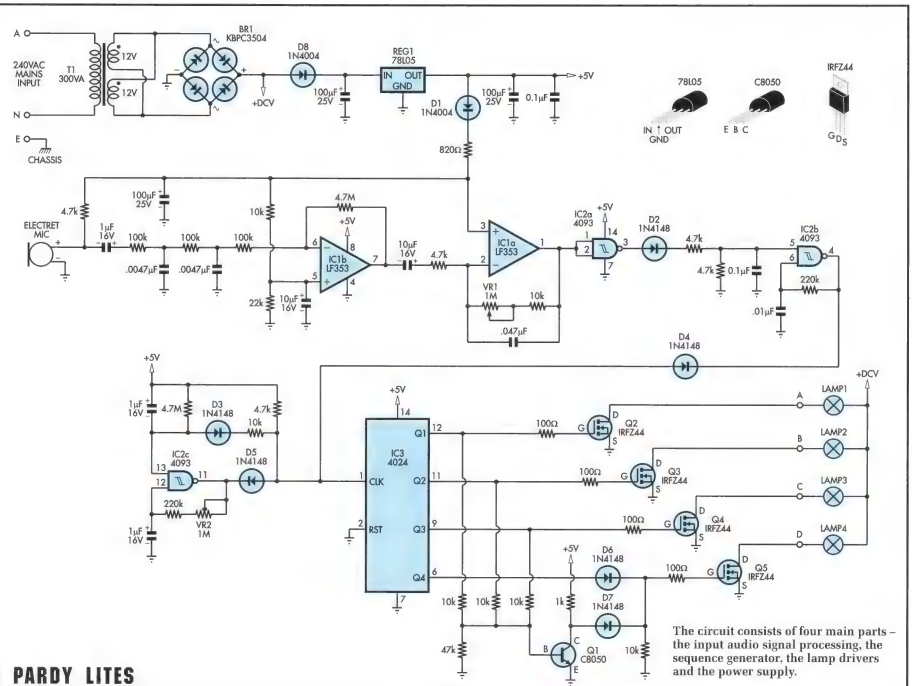
Another oscillator is formed around IC2c, similar in configuration to that based on IC2b. The main difference is that the frequency of this oscillator is adjustable via VR2. This is used to clock the counter in the absence of an audio input signal.

When an audio signal is present, the output of IC2b will be low often enough to allow the 1µF capacitor between +5V and pin 13 of IC2c to charge (via another 1N4148 diode and 10kΩ resistor). As a result pin 13 of IC2c will be low, thus disabling this oscillator. However when the music stops, the capacitor will discharge the 4.7MΩ resistor, allowing pin 13 to go to a logic 1 and therefore allow IC2d to oscillate.

It takes approximately 5 seconds for the 1µF capacitor to discharge sufficiently to allow the input to this gate to reach a logic 1. Therefore, if the music stops for approximately 5 seconds, IC2c starts to oscillate and the counter automatically generates its own effectively random display sequence at a frequency set by VR2.

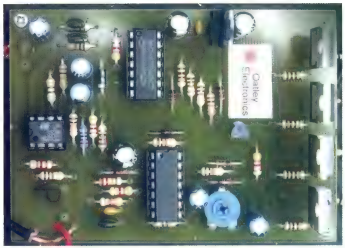
The four least significant outputs of IC3 are connected to the gates of the power MOSFETS that are used to drive the lamps.

These devices have no problems in driving a 50W halogen lamp without



The circuit consists of four main parts – the input audio signal processing, the sequence generator, the lamp drivers and the power supply.

PARDY LITES



The PC board component overlay above and a matching photograph to help you put it all together. Provision is made for VR1 (sensitivity) to be a preset mounted on the PC board but would more logically be an externally controllable pot, as shown here. It is shown as a linear type but if you have a log pot, use it! VR2 could also be external if you wish to have external speed control of the oscillator.

Note that the photo and PC board layout both show an error involving the 10kΩ resistor immediately above the IC in the centre of the board. A correction for this is given at the end of the article (P72) but future production runs of PC boards may have this error corrected. Check the kit for any note to this effect.

a heatsink; any more than this, though, and we would be tempted to fit each one with a small U-shaped heatsink.

There is one minor complication concerning the ripple counter. It is possible for one of the counts to be 0000, a situation which would cause the display to turn off completely.

This problem is solved by the addition of transistor Q1 and three 10kΩ resistors connected to the first three outputs of the ripple counter.

If those three outputs are at logic 0, transistor Q1 is turned off and its collector voltage goes high, therefore a high is applied via diode D6 to the gate of MOSFET Q5, turning it on and lighting its lamp, irrespective of the state on the fourth output.

Q5 is turned on (and its collector low) when any of the first three ripple counter outputs are at logic 1.

Power supply

A 300VA toroidal transformer supplies the power to drive the circuitry. It has two 12V @ 12.5A secondaries which are connected in parallel, feeding a nominal 12V AC @ 25A to a 35A bridge rectifier. The output from the rectifier is connected directly to the 12V halogen downlights.

Because there is no filtering of the DC supply to the lamps, there is a lot of flicker in them. However, this doesn't detract from the effect; in many ways, it enhances it.

Output from the ripple counter is such that no more than three lights can be on at one time, with a combined current of about 12A (3 x 50W/12V). Therefore the transformer is operating well within its ratings.

However, if you add extra MOSFETs and lamps as suggested above, consideration will need to be given to the transformer/rectifier ratings.

A 7805 regulator provides the low voltage supply to run the control circuitry. No heatsink is needed on the regulator but a reasonable heatsink is needed for the bridge rectifier, especially if four 50W bulbs are used.

Construction

As usual, we'll start with assembling the electronics. After checking the PC board for any defects, solder in the lowest-profile components first – resistors, diodes, transistor, capacitors and the IC sockets (if used).

If you have any doubt about the colour code on the resistors, check them before soldering them in with a multimeter (preferably a digital one). Also refer to the table showing the colour codes for both 4-band and 5-band resistors.

All semiconductors and the electrolytic capacitors are polarised, so make sure they go in the right way around. The same comment applies to the IC sockets.

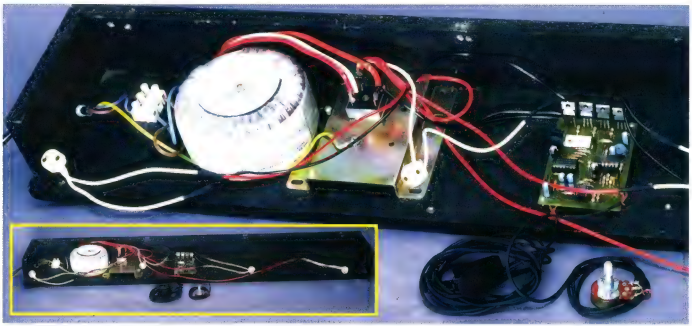
Finally, solder in the four MOSFETs and the regulator and place the ICs in their appropriate sockets. Check over your soldering and component placement.

Power supply wiring

Follow the wiring diagram for the power supply exactly, especially the mains side of the transformer. It is essential to get the colour coding correct on the windings – not just for your own safety but also 'cos it won't work if you get it wrong!

If you don't use the transformer specified, check and double check the colour coding on the one you use. It is common that the mains side of the transformer has two wires the same colour while the secondaries are usually thicker wire.

If you connect the secondaries in parallel but get no voltage out (and the



Here's the "works" mounted in the custom-built case with the lid removed and the four lamp bases (which come with the gimbal fittings) disconnected. The main shot shows the business end while the inset shows the whole thing.

transformer is OK!) you have connected the windings out of phase. Reverse one set of windings (not both!) and you should get your 12V AC output.

While on the subject of transformers, Oatley Electronics have available some very cheap 9V+9V 250W toroidals which could be used as is (the halogen bulbs won't be as bright and probably won't last as long) or you could be really clever and add a few turns to each of the secondaries to bring them up to 12V out.

As mentioned before, the bridge rectifier needs to be mounted on an adequate heatsink. We used a scrap of steel (actually an old mounting plate from a transformer). Of course you can also buy a wide range of heatsinks.

To ensure maximum heat transfer between the rectifier and heatsink, some heat transfer compound should be smeared on the metal surface of the rectifier before it is bolted firmly to the heatsink.

Hardware

Our display used four 12V, 50W halogen "downlights" (mounted as "uplights"!) in a 1000mm (l) x 155mm (w) x 80mm (h) case made from 16mm chipboard or MDF.

Standard gimbal halogen downlight fittings were used as these give a two-direction adustment, allowing you to aim the beams of light where they will be most effective. These are commonly available for about $10-12. In fact, Woolies sell them complete with transformer for about $20 but unfortunately the transformer will only handle one 50W globe. (But you would get a very nice 12V transformer which you could use for other projects!). Don't be tempted to use an "electronic" halogen transformer.

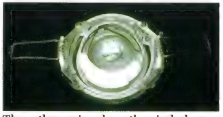
The gimbal fittings, which have an outside (front) diameter of about 100mm, require a mounting hole of about 90mm or so. They have two springs which hold them in place on the box.

When you cut the holes in the box top, make sure you allow enough room for the springs to clear the box ends.

Of course, all this assumes you are making a display the same as ours. If not, let your creative juices flow and do your own thing!

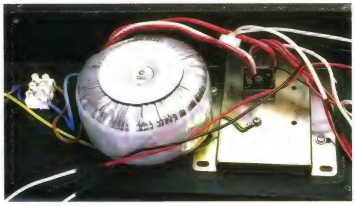
The globes

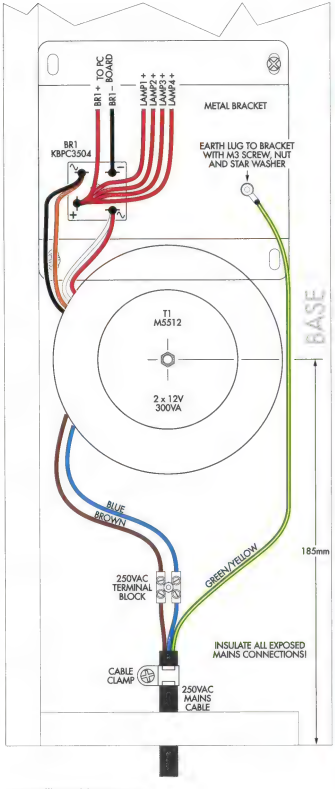
Coloured (red, green, blue and yellow) 12V 50W halogen globes are available from Jaycar Electronics stores for



These three pics show the gimbal fittings and how they are mounted in the case. Left, the fitting on its own. Above, one fitting mounted and below, all four fittings mounted in the box.

Follow this diagram and photo when wiring the transformer and bridge rectifier. All low voltage wiring must be capable of handling the currents involved. We have shown the wires going to the four halogen bulbs as "LAMP1+" etc. Of course, these bulbs are not polarised but it might be easier to think that one side of the bulb goes to +ve and the other, via the switching MOSFET on the PC board, to -ve.





Parts List – Pardy Lites

1 PC board coded K170, 87mm x 62mm
1 16mm particle board case, approx 1000 x 140 x 80mm (see text)
4 halogen downlight gimbal fittings with wired ceramic lamp bases (sockets).
4 12V 50W coloured halogen downlight bulbs
1 toroidal transformer, 2 x 12V 12.5A secondaries
1 metal heatsink (see text)
1 2-metre 3-core mains power lead with 3-pin plug
1 mains cord clamp
1 3-way terminal block
1 electret microphone with cable and 3.5mm plug
1 3.5mm mono socket
1 mounting plate for microphone socket and sensitivity pot (see text)
Suitable lengths 10A hookup wire (for wiring lights to PC board)
Spaghetti insulation or heatshrink tubing
Woodscrews (for assembling case and for mounting PC board and heatsink to case)
1 M3 screw, nut, star washer & solder lug

Semiconductors

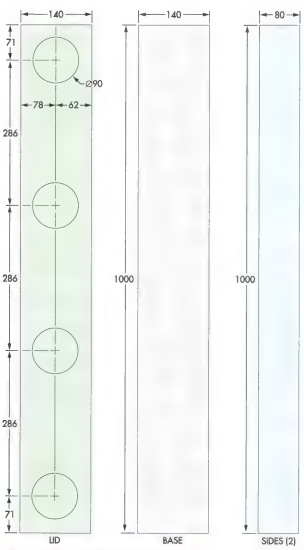
1 LF353 dual JFET op amp (IC1)
1 4093 quad 2-input Schmitt NAND gate (IC2)
1 4024 7-stage ripple counter (IC3)
2 1N4004 silicon power diodes (D1, D8)
6 1N4148 silicon signal diodes (D2- D7)
1 C8050 general-purpose NPN transistor (Q1)
4 IRFZ44 power MOSFETs (Q2-Q5)
1 78L05 5V low power positive regulator

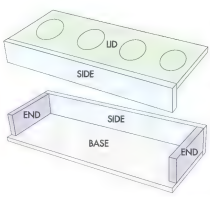
Capacitors

3 100µF 25VW PC mounting electrolytic
2 10µF 25VW PC mounting electrolytic
3 1µF 25VW PC mounting electrolytic
2 0.1µF MKT polyester
1 .01µF MKT polyester
1 .047µF MKT polyester
2 .0047µF MKT polyester

Resistors (0.25W, 1%)

1 4.7MΩ 1 220kΩ 3 100kΩ 1 47kΩ
8 10kΩ 6 4.7kΩ 1 1kΩ 1 820Ω
4 100Ω
1 1MΩ potentiometer, taper unimportant (VR1)
1 1MΩ trimpot (VR2)





We made our case from a piece of 1-metre long 16mm chipboard, with the dimensions as shown here. However, there is nothing to stop you from changing any or all of the dimensions –just so long as everything fits in without fouling other bits!

ours from craft stores which handles the heat of the globes without problems (we've used it many times on halogen bulbs in theatrical work).

Or you can buy pieces of coloured glass from a glass supplier (or a leadlight supplier) and mount them over the front of the globes. The advantage of both these methods is that the range of colours is very much greater than the four "primary" colours above.

Error on PC board

As we went to press, we discovered an error on the PC board. It won't stop the project working but doesn't let it work as well as it should.

The 10kΩ resistor immediately above IC2 connects to the cathode of D4 where it should connect to the anode. The easiest way to fix this is to solder the resistor *under* the PC board as shown below. This view is shown from the component side of the board (ie, looking through it with X-ray vision). **SC**

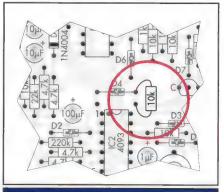


Table 1: CAPACITOR CODES

Value	IEC Code	EIA Code
0.1µF	100n	104
.047µF	47n	473
.01µF	10n	103
.0047µF	4n7	472

about $7.00 each. That's not bad value, considering ordinary white globes sell for only a dollar or so less. You can buy cheaper globes from a supermarket – about $4 each or so – but our experience with the life of these is not particularly good.

Why are we mentioning white globes? Simple – they can be coloured. You can buy glass paint in many col-

Table 2: RESISTOR COLOUR CODES

No.	Value	4-Band Code (1%)	5-Band Code (1%)
☐ 1	4.7MΩ	yellow purple greenbrown	yellow purple black yellow brown
☐ 1	220kΩ	red red yellow brown	red red black orange brown
☐ 3	100kΩ	brown black yellow brown	brown black black orange brown
☐ 1	47kΩ	yellow purple orange brown	yellow purple black red brown
☐ 8	10kΩ	brown black orange brown	brown black black red brown
☐ 6	4.7kΩ	yellow purple red brown	yellow purple black brown brown
☐ 1	1kΩ	brown black red brown	brown black black brown brown
☐ 1	820Ω	grey blue brown brown	grey blue black black brown
☐ 1	100Ω	brown black brown brown	brown black black black brown

Wheredyageddit?

This kit was designed by Oatley Electronics who hold the copyright on the design and the PC board. Oatley Electronics have available the following kits/components:

Short Form Kit: (PC board, all on-board components, bridge rectifier and metal heatsink): K170 $35.00

Contact Oatley Electronics on (02) 9584 3561, fax (02) 9484 3564 or via www.oatleyelectronics.com.

Coloured Globes: Jaycar, SL2741/2/3/4, $6.25 each

Specified Transformer (12V/12V 300VA): Jaycar MT2130 @ $83.95, Altronics M5512 @ $72.50

Oatley 9V+9V 250VA Toroidal Transformer (see text) $30.00

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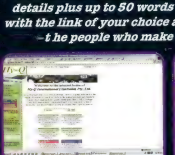

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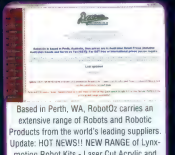

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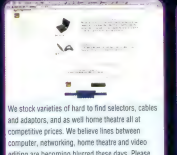

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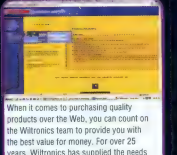

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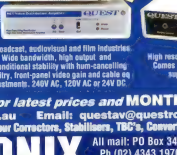

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PRODUCT SHOWCASE

Ricoh's new combined DVD and CD Rewriter

Ricoh Australia claims their new MP5120A "Super Combo Drive" is a world first, combining DVD+RW and CD+RW in one unit. It is the first rewritable DVD drive solely complying with the DVD+RW standard while also working as a CD-RW.

Ricoh also released DVD+RW disks to coincide with the launch.

The MP5120A offers two-way compatibility meaning that DVD+RW media can be played in the majority of existing DVD-Video players and DVD ROM drives.

The MP5120A is capable of 2.4x write speed which is equivalent to 22x write speed on a CD drive.

In addition, the direct-to- DVD function enables direct recording of video from VCR and digital video camcorders and the bundled software will support a variety of applications.

The Ricoh DVD+RW disks will hold 4.7GB, the same as a DVD-ROM. "

The drive is available from Ricoh specialists Australia-wide.

Contact:
Ricoh Australia
1800 646 679 or
www.ricoh.com.au

Tiny LCD monitor

This compact CCTV TFT LCD col our monitor from Mastatek offers PAL NTSC video input and comes com plete with monitor speaker and stanc A 12V DC mains adaptor is availabl as an option.

Specifications and facilities for thi very portable monitor include a screer size of 5.7 inch (diagonal) and a dis play resolution of 960(H) x 234(V dots. Dimensions are 168(W) x 133(V x 40(d) mm and the total weight i 610g. Power consumption is DC 12V 600mA 8W (max).

Additional functions include screer side right-left switchable and up-dowr auto switch.

More detailed brochures and pric ing information is available on request

Contact:
Mastatek Pty Ltd
Ph (03) 9753 4300, Fax (03) 9753 4322
www.mastatek.com.au

Mighty ATOM from Microzed!!!!

MicroZed Computers have added Basic Micro products to their range of products. Included is a "Stamp2" look-alike, BASIC compilers, chip programmers and development boards.

The Stamp2 look-alike "ATOM" is pin-compatible with the Basic Stamp 2 and can be used in any Basic Stamp development board.

Based on the PIC16F876/20, the ATOM and OEM ATOM modules have an execution speed of 33,000 instructions per second, 8K of program space, analog-to-digital conversion, interrupt capability, floating point maths, hardware PWM and many other desirable features. The ATOM can even play an 8-note musical chord!

ATOM firmware is field upgradeable and as well as the usual commands its command set includes such nice features as LCDWRITE and LCDREAD (did you know LCD panels with the Hitachi chipset have an area of RAM?).

The ATOM can drive stepper motors and servo motors with single commands. There is no need to write a routine.

Basic Micro manufacture a programmer and ZIF adapter that will handle PIC, ATMEL and SX chips, but at this stage they only have PIC Basic Compilers, in two versions, plain and PRO. The ATOM development board has two sockets, one 24-pin 0.6inch DIP and the other a 14-pin SIP for OEM ATOM.

Other development boards are for 18, 28 and 40 pin chips. Most development boards are solderless "breadboard" style but some solder pad versions are availble too. Of special interest is the LCD development kit, which allows the end user to make their own LCD driver chip to their own specs.

Bob Nicol of MicroZed Computers says that the new range of Basic Micro products is intended for professional use but Basic Micro have not forgotten the beginner in BASIC.

More information is available on Microzed's website.

Contact:
MicroZed Computers
PO Box 634 Armidale NSW 2350
Phone: (02) 6772 2777
Fax (02) 6772 8987
Website: www.microzed.com.au

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Keep it safe safe . . .

If you have something you want to keep safe, a visit to a Dick Smith Electronics PowerHouse should be on your agenda.

They have just added a compact (340 x 200 x 240mm) electronic combination lock safe to their range of security products. It has a 3mm thick body and 6mm thick door and weighs in at 18 kilograms.

The safe can be programmed with any three to eight-digit code by way of a front panel keypad and it also has a manual key which overrides the electronics. There is a built-in safeguard to prevent intruders continually punching numbers – if the wrong code is entered three times the safe will not accept more tries for twenty seconds. Another three wrong codes and it locks up for an hour.

Three LED displays on the front panel indicate the security and power status of the safe. The four "D" size batteries required to power the safe are included in the $147 price.

The safe is only available from DSE PowerHouse stores (or through Direct Link, 1300 366 644, or the DSE website).

Contact:
Dick Smith Electronics (PowerHouse)
Phone: (02) 9642 9100
Fax (02) 9642 9153
website: www.dse.com.au

Home phone can travel with you

Looking for something a bit different for Christmas?

A new cordless phone from Uniden offers much more versatility than traditional cordless models. The 900MHz digital spread-spectrum phone can communicate with up to seven handsets, allow handset to handset transfers and even allows 2-way communication between handsets when away from the base unit.

This means that the $249 Uniden T3 system, which includes caller ID, can double as an intercom or even, for example, be taken on holidays, to the beach or anywhere else and allow two-way communication between family members.

Uniden have also announced their "Call Ezi" plan for homes and small businesses which offers a free digital cordless phone and competitive call rates (including free calls each month) on a 24-month plan.

Contact:
Uniden Australia
Phone: (02) 9599 3355
Website: www.uniden.com.au

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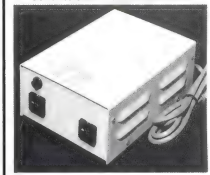

Harbuch Electronics Pty Ltd
9/40 Leighton Pl. HORNSBY 2077
Ph (02) 9476-5854 Fx (02) 9476-3231

Electus wholesale goodies catalog

Electus Distribution have released a 306-page catalog featuring electronic components, hardware, service gear, tools, test equipment, surveillance gear and more.

Everything in the catalog is priced, making lookup and pricing much easier than many supplier's catalogs. The information is also available on CD-ROM.

The catalog is for professional, commerce, industry and education users.

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Phone: 1300 738 555 (02) 9741 8552)
Website: www.electusdistribution.com.au

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This month order via the web & get a FREE A 9250 CD travel wallet valued at $10.45

Jack O'Donnell, Managing Director

Remember the "Altronics Virtual Store" is open to order 24/7 right through out the Xmas period.

"with all orders over $100

Be First In Line!

The Altronics 19th edition 2002/2003 catalogue is due for release in March 2002. Filled with many new and exciting products, more data and specifications than before, it has got to be the best yet!

To register in advance for your FREE copy either e-mail us at:

catalogue@altronics.com.au,

register on-line via our website:

www.altronics.com.au,

or phone us on 1300 797 007.

Priority will be given to e-mail requests.

Pro LAN Cable Tester

This unit will not only check all 8 conductors, but it will also check shielding integrity where shielded cable has been used. PLUS it can also check Coax wiring with the included BNC to RJ45 adaptor!

Features: Auto/Manual mode • LED indicators for all connections including Ground • Will test 10Base-T, 10Base-2, RJ45, 258A, TIA 568A/568B and Token Ring • BNC to RJ45 Adaptor included • Includes Soft carry case

Suitable for 4, 6 and 8 pin modular connectors, PLUS BNC connectors!

D 3010 RRP$179 **$149**

iroda 50W Gas Soldering Kit

One of our most popular models at portable soldering products is now in a gift box pack!

T 2596 RRP $69.95 **$59.95**

NEW!

Features: Compact • Up to 50W heat output • Cap mounted flint lighter • Up to 1 hour use per refill • Four interchangeable tips ; conical soldering , hot blower, hot knife & flatwork tool • Variable heat output • Integral safety wire stand • Iroda's "no risk" 12 month replacement warranty

*sorry not available from dealers

Colour Web Camera

Packaged with heaps of software and functions, this little treasure is just what you need to get real personal with your computer. Great for video conferencing, emails, games, etc. Works with windows 98 & 2000 and requires a USB connection.

NEW!

D 0950 ONLY **$89**

Uninterruptible Power Supplies

Not just for PCs , protect your other valuable electronic equipment!

D 0666 RRP$299 **$178**

D 0679 RRP$449 **$229**

These professional quality uninterruptible power supplies will guard your computer from damage caused by power failure. Supplied complete with monitoring software and cables to ensure your computer is carefully shutdown without any loss of valuable data. 250VA will suit an average Pentium PC whilst the 425VA is ideal for servers.

Features: Compact • Three battery backup GPO's & 2 non backup GPO • All outlets spike & surge protected • Fits standard 3 pin mains plug • RJ12/45 telephone spike protection • Comprehensive auto shutdown software • Circuit breaker protected • Two models available

600W of Roar Power!

With up to 600W of power , "D" Class MOSFET technologes and configurable in four, three or two channels the C 9250 is ideal to form the core of a thunderous car audio system.

C 9250 ONLY **$289**

FREE! Purchase the C 9250 for $289 & we will throw in a whole 50m roll of W 2140 Oxygen Free whopper wire valued at $80.00.

Features: 4/3/2 Channel operation • Stable into 2 ohms • Separate gain controls for each audio channel • 6dB or 12dB bass boost • Gold plated contacts • Stylish low profile chassis • Low THD • Adjustable front and rear low pass/ high pass filters • Low power speaker or line level inputs • Bridgeable terminals

Hygrometer & Thermometer with Clock

Includes backlighting

Ideal for fish tanks, home brew kits, cellars, hot houses!

Features: Large LCD display • 12/24 hour clock • Internal/External temperature sensor • Humidity • Backlighting • 4 mode temperature alert (audible alarm), within range, out of range, high & low temperature • -50°C to +70°C • Max/Min memory

A 0156 RRP$47.50 **$40**

Superb In-car sound!

This month save over 20%!

Ideal xmas gift for the automotive audiophile

These high quality, extremely responsive speakers are ideal for the beginnings of a superb car sound system. Optimised for infinite baffle for use as parcel shelf speakers.

Features: 250W max power, 88W RMS • 4 ohms impedance • Infinite baffle optimised bass driver • 60Hz - 18KHz Freq. response

C 9995 RRP$99 **$79**

12" Subwoofer

Just the shot for adding some weight to your hi-fi, car audio, or home theatre system. This 300mm 8Ω driver has a super-rigid Poly Emulsion Coated Cone, with a high-efficiency foam surround has low-Q, low resonance and high efficiency.

Save 25% on some serious bass

C 3100 RRP$99 **$69**

Pmax: 100W RMS, **Fo:** 25Hz, **Sensitivity (1W/1m):** 92dB, **Cts:** 0.342, **Vas:** 207.8L

19 Range Pocket DMM

Small enough to fit into a pocket, yet versatile enough to use on just about any job. Includes a backlit display for jobs in poorly lit areas.

Features: Range hold & data hold • Auto power off • °C Temperature range • AC • 400mV - 600V • DC Volts • 400mV -600V • Resistance • 400Ω - 40MΩ • Continuity buzzer • AC/DC current • 400µA - 10A • Transistor tester • Diode check • Rubber holster included

Q 1126 RRP$40.50 **$29**

Includes temperature probe measures from -20°C to 1370°C

FREE This month purchase a Q 1126 for $29.95 and we will give you a FREE carry case valued at $5.55 to keep it protected.

Programmable / Learning Remote

Consolidate your Hi-Fi, TV, VCR, DVD and up to six other remote controls into one slimline stylish control unit!

Features:

- Stores up to 47 functions per device
- Large easy to read display
- Equipped with date, time & alarm clock
- Sleep Function
- Low battery Indicator
- Up to 20 Macro functions
- Intelligent backlit LC display

Why put up with this? *

When you can have this

A 1002 RRP$119 **$99**

SERIOUS PC Sound System

We have scooped this fantastic 3pc multimedia speaker sound system. If you are an avid MPEG user or just like listening to your favourite CD while you work, you will really enjoy these! The system consists of a left, right and a SUPER SUB-WOOFER to get some serious sound from your PC, Portable CD player, TV, Bookshelf system, etc.

D 0805 ONLY **$69**

Catch thieves *RED* handed!

This 4 channel event recorder will automatically activate a VCR via an external remote trigger such as a PIR or reed switch. Break-ins are then recorded from the CCD camera(s) you have monitoring your home or office.

S 9450 ONLY **$249**

Features: Suits most brand VCRs • Simple to install • Inbuilt time clock & date "stamp" • Monitor up to 4 camera inputs • Separate output to trigger external alarm or additional units ganged together • Infra-red learning remote control

S 9454 Lead to suit $27.95

M 8235 12VDC 1A power supply: $49.00

Record video footage only when a break-in occurs! & catch thieves in the act!

NiMH Battery Charker

Get in ahead of time & pickup batteries & a charger for those christmas presents! Good for up to 1000 recharges.

Features: Fits into a standard general purpose outlet • Safety cover prevents accidental touch during charging • Charges 2 or 4 batteries at a time • LED charging indicators • Suitable for AAA or AA NiMH batteries

FREE! 4 x AA batteries

Z 1028 RRP$60 **$50**

KEY CHAIN LASER POINTER

Perfect for seminars, lectures, building sites or guided tours.

FREE!! 3 Spare batteries to suit with every A 0205 sold this month (valued at $4.80)

A 0205 RRP$29.95 **$15**

Ordered by 2.00PM WST Country areas please allow an additional day for delivery. Prices may change without notice. Not all lines are kept in stock. Not available to P.O. boxes.

Express Order Hotline 1-300 797 007

order online: www.altronics.com.au • fax order line 1-300 789 777

12 months minimum warranty

ALTRONICS

Datalogging Digital Multimeter

The Brymen® Q 1080 DMM is truly an amazing piece of test equipment with features only found in meters 2 or 3 times the price!

240V Rated. Meets EN61010–1: IEC1010–1, CATII 1kVDC/750VAC, CATIII 600VAC/DC with 6.5kV transient protection!

Features: Auto ranging • EF Detect • Data Hold • Temperature • AC/DC Voltage 250mV–750V • AC/DC Current 250µA–10A • Resistance 250Ω–25MΩ • Diode Check & Buzzer • Optically Isolated RS232 Interface (optional Q 1082) • Optional temperature probe to suit (Q 1092)

Detects 240VAC mains without even connecting a single test lead!

Q 1080 RRP $160 **$129**

FREE Xmas Bonus

Purchase the Q 1080 for $129 & we will throw in a Q 1082 datalogger RS232 interface valued at $26.25 at no extra charge.

NEW KITS FOR 2001

Single DI Box Kit *with* EQ

(SC Aug. '01) Converts high impedance devices (ie. guitars, synthesizers) to low level balanced outputs to be fed over long lines reducing hum & noise.

Features: 3 band graphic equaliser • Ground Lift switch for hum loop control • Housed in a slimline case • Input level controls • Powered from a 9/12V DC source

M 9271 12V DC 300mA Plugpack to suit $14.85

K 5553 RRP $74.95 **$64.95**

Ultra LD 100W Stereo Amplifier Kit

(SC Nov-Dec '01) Rated at 100W RMS per side & producing almost unmeasurable levels of distortion, this amplifier looks so good that your friends will not believe that you built it yourself.

As featured in this months Silicon Chip!

K 5155 ONLY **$699**

Features: LED bargraph meters • Gold plated speaker terminals • Simple to construct • 19" Rack or desk mount • Screened and CNC pre-punched chassis for a professional finish • CD, Tuner, DVD, Tape & Auxiliary inputs • Ultra quiet at -109dB A weighted ✪ full power

MP3 Jukebox Kit

(SC Sept - Nov '01) Turn your PC into a remote controlled jukebox.

Features: Works with most universal remote controls • 16 x 2 Alphanumeric display • Simple serial interface • Slots into a standard 5.25" Floppy drive bay

A 1013 Remote to suit normally $36.00

K 2750 ONLY **$89.95**

Wireless Intercom Unit

This fantastic intercom system is so simple to install. Just plug it in to a standard mains power point & your in business!

An ideal addition to a garage workshop or baby room

Features:
- In Use indicator
- "Talk Lock" operation (for use as baby monitor)
- Call button
- 240V operation
- No wiring required

P 7002 ONLY **$69**

DISCRETE SURVEILLANCE!

Ideal for large open viewing areas!

This "Hawk-eye" dome camera flush mounts & discretely blends in to your ceiling.

Features: An "eyeball" style swivel mount • 380 lines resolution • Black & white CCD sensor

S 9105 ONLY **$149**

M 9449 1.5-12VDC 500mA Reg. plugpack $31.85

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Smoke detectors could save your life! and new homes must have them fitted by law in most states

Features: 5 Year Warranty • Complies to Australian standard • 85dB SPL

Don't trust your life to a non reputable brand, rely on Quell®

- Battery low alert • Detects visible & invisible smoke
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	ONLY
A 0420 General Purpose	$14.00
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Waterproof Remote Control

This water resistant pre-programmed remote control is extremely easy to use and program. It can replace up to 8 controls and can operate the following items - TV, VCR, VCD, DVD, LD,CD, Satellite, Cable Set Top Boxes. Suits most top name brands.

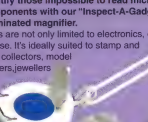
A 1013 RRP $35 **$24.95**

Ideal for outdoor entertaining, or pool-side parties!

INSPECT-A-GADGET ILLUMINATED MAGNIFIER

Identify those impossible to read micro miniature components with our "Inspect-A-Gadget" Illuminated magnifier.

Uses are not only limited to electronics, of course. It's ideally suited to stamp and coin collectors, model makers,jewellers etc.



A 0970A RRP $145 **$99**

Features: 2x Magnification • Illuminated • Measures approx 140 x 40mm • Requires 2 x AAA batteries (not incl.)

Aluminium Tool Case

Rugged construction makes this tool case ideal for a service personal tool case , laptop case or camera & accessories case.

Measures 460 x 325 x 150mm

*Toos shown not included

Beware of inferior quality cheaper models on the market which have plastic sides and are less robust!

Bonus offer!

Purchase the T 5020 tool case this month & receive a set of insulated screwdrivers valued at $17.80 at no extra charge!

T 5020 ONLY **$65**

Pocket Blow Torch

Powered by a refillable gas lighter (supplied), this unique blow torch burns at 1300°C, making it ideal for many types of brazing and heavy duty soldering. The Micro Jet can be ignited and used simply with one hand. It has an in-built piezo electronic ignition system which ensures easy lighting every time.

"The little blow torch has to be the refillable tool of it's type we have ever seen!" **Silicon Chip Magazine**

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T 2490 RRP $28.95 **$19.95**

A BENCHTOP POWER SUPPLY FOR LIFE!

This power supply is ideal for service work , project design & testing a wide range of electronic appliances.

>0.05% Regulation making this idea for testing & prototyping digital circuits

Features: Delivers up to 3A current • Separate controls for voltage and current limiting • Fixed 12V & 5V output rails • Fully adjustable from 0- 30V • Precision LCD voltage & current meters

M 8200A RRP $275 **$225**

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*Unless specified otherwise, all products are covered by a 12 month minimum warranty

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PIC FUN AND

Way back in time, last century even, we presented a neat little PIC-based project called LED FUN. Here's its big brother, another PIC project called PICFun2. And while it can flash LEDs, it is capable of doing a whole lot more!

Actually, the project we referred to above wasn't all that long ago – February 1999 to be precise (it just seems long ago!). LED FUN was based on a PIC12C508 which was programmed to flash LEDs in a variety of patterns.

The board was designed and produced in Australia by Labtronics. Now reincarnated as eLabtronics, the new project, PICFun2, is based on a more powerful PIC, the 16F84.

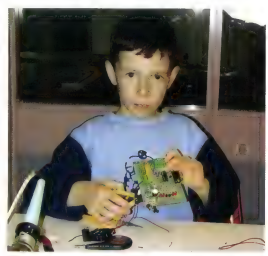
PICFun2 has more than one aim. In its "bare bones" form, it's basically just a PIC on a PC board with a sprinkling of components to enable you to connect it to the outside world (or, more correctly, the inside world – the inside of your personal computer!).

It's designed as an educational aid, something for (especially) school students (or anyone else) to "cut their teeth" on in the world of microcontrollers. Indeed, the manual supplied (on an accompanying CD-ROM) goes into a great deal of explanation into just what a microcontroller is and what it does, long before you get to touch a soldering iron! There's even a trial version of some software to help you program – but more on this shortly.

But it's much more than this. The project software provided on the CD-ROM shows just a couple of things you can do with PICs. Once you've learned how to drive them, you're ready to start writing your own code to do, well, whatever you want to.

Why would you want to learn about microcontrollers, and PICs in particular? Well, they're in such common use today that an understanding of them is almost essential for anyone interested in furthering their electronics knowledge, whether that be at a hobby, student, technician or professional level.

When we say common, we mean it. Unless you've just woken up, the chances are that already today you've used not just one, but several devices containing PICs or other microcontrollers. In fact, if you woke up to an electronic alarm clock or clock radio, it probably contained one!



When they say PICFun is child's play, they mean it! Here is 8-year-old Emilio who built a PICFun2 kit – and it worked first time! (This version actually has a bit more on it than the basic PICFUN2 described here.)

There are many different types of PICs (and other microcontrollers). Some, such as the type we are using here, can be programmed and erased hundreds, often thousands of times. Others, such as the ones used in commercial equipment, can be programmed (or "written to") only once. Their program cannot be erased – to change the program, you have to change the chip. These are much cheaper to produce than the re-programmable type and are used when all of the code has been tested or "debugged", ready for a production run.

If you want to know more about PICs and microcontrollers, there is a lot more in the PICFun manual on the CD-ROM – a ***lot*** more!

What you get

In the PICFun2 kit, there is a small PC board, the PIC chip (16F84) with an 18-pin IC socket, a buzzer, a 9-pin male D socket, a couple of PC board mounting terminal blocks, a battery holder (no batteries!), a slide switch and a pushbutton switch, some resistors, capacitors, diodes, LEDs and a transistor, along with some hookup wire.

On an accompanying CD, there is a range of software, manuals – even a technical manual on the PIC16F8X range – and various other information. This CD-ROM is PC (ie, IBM) compatible.

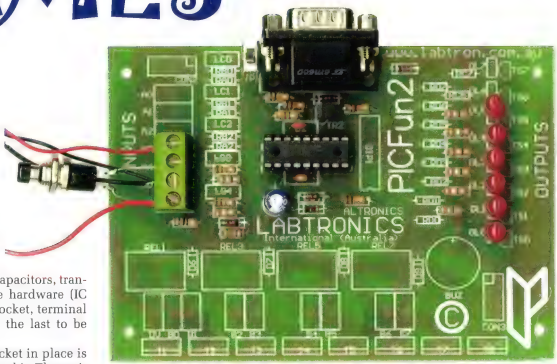
Putting it together

The first thing to do is completely ignore the PC board component layout in the instruction manual. It will confuse the heck out of you for two reasons: (a) it's an earlier PC board (new ones are different!) and (b) it shows a different project to what you're building here. Use the PC board component layout we've shown here and the accompanying photo.

Step-by-step instructions are given in the manual but assembly is basi-

GAMES

By Ross Tester

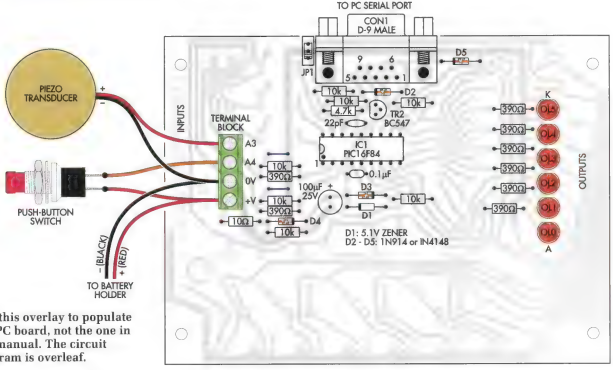


In its most basic form, there isn't much to PICFun2 – apart from the PIC chip itself there is just an input from your PC (the D9 connector), power supply and some output LEDs. But this is only the starting point. PICFun2 can be expanded to do a lot more than flash LEDs!

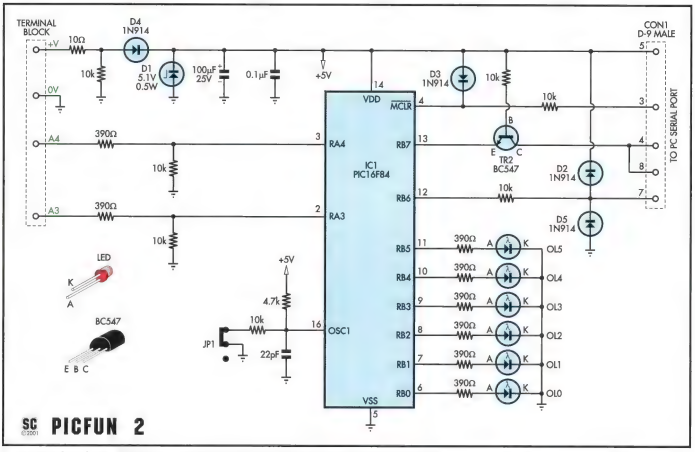
cally the same as any other kit: start with the lowest profile components first – the resistors, followed by the diodes, capacitors, transistors and LEDs. The hardware (IC socket, switches, D9 socket, terminal blocks and buzzer) is the last to be soldered in place.

Soldering the D9 socket in place is probably the most tricky bit. The easiest way to do it is to undo the nuts on each end which hold the plug shell in place (remember which way up it goes!), soldering the pins to the PC board and then replacing the shell and the nuts.

Also the on-board terminals need a bit of explaining: you slide these to-



Use this overlay to populate the PC board, not the one in the manual. The circuit diagram is overleaf.



In its simplest form, PICFun2 contains only the PIC chip itself, some power supply components, the interface to your PC and some output LEDs. The manual has a number of programming suggestions.

gether to form a four-way terminal block before soldering them in place. The "open" side of the plug (ie, the bit where you poke in the wires!) has to face to the outside edge of the PC board.

And lastly, the LEDs: the manual makes some comment about aligning all the LEDs so that their longer leg (the so-called "negative lead" – we'd call it the cathode!) goes "via the thick track to the negative rail".

What they should simply say (we think!) is that all the LEDs should be soldered in so that their flat sides are facing the top of the board as you read the labels. Now that's a tad simpler, isn't it? And yes, there are a couple of LED positions not used.

What you should end up with is a PC board similar to that photographed on page79. As you can see, there is not a lot of the PC board "populated"; that is for later expansion when you start doing really clever stuff with the PIC.

Testing the board

Having assembled the hardware for the controller the next step is to test it.

First of all, you need to supply power. The manual talks about 3 x "AA" cells but a 4 x"AA" cell holder is supplied. Use four cells, otherwise you will have an open-circuit power supply! The 5.1V zener diode included in the circuit will regulate the voltage to within the PIC's specs.

Install the software provided with the PICFun2 kit. Start the program Picplc. This program is used to send code in binary format to the 16F84 for programming. Code for this is obtained from the appropriate *.hex file.

When started you will be asked for the location of the hex file you wish to download. Load the file and the number of the serial port being used for programming (ie: c:/PICFUN/mode1.hex 2 where 2 is the com port and the file is located in the c:/PICFUN directory). Leave a space between the x and the number.

It is suggested that you use the mode1.hex file for the test. This is found amongst others on the disk provided.

Follow the steps below. They will lead you through the processes required to program the chip as well as providing a test for its successful construction.

Step 1

Connect a 9-pin serial cable (not supplied with the single version of the educational kit) from the D9 port connector on the microcontroller to an available serial COM port on your computer. You will need to know if it is COM 1 or 2 that you have selected. Check the gender of the connectors on your cable. A gender changer may be required. (The cable is a 1-1 wired serial cable female to female, 9 pin to 9-pin or 9-pin to 25-pin).

Step 2

Run START on the supplied CD. Install all the software (PICFun and MPLAB) and drivers to drive C:/ PICFUN of your computer. You will need approximately 5Mb of hard disk space.

Step 3

With the computer off, connect the PICFun2 to the serial connection on your computer, then start the computer. Keep the serial lead and programmer connected during start up and the

Parts List – PICFun2

1 PC board, 80 x 48 mm, coded PICFun2
2 PC board mounting terminal blocks
1 18-pin IC socket
1 piezo buzzer
1 miniature pushbutton switch, NO contacts
1 SPST miniature slide switch, PC board mounting
1 4xAA battery holder
4 AA batteries (not included in kit)
1 9-pin "D" serial interface connector, right-angle PC mounting
1 "straight through" serial cable, 9-pin female to 9-pin female
Hookup wire

Semiconductors
1 PIC 16F84 microcontroller IC (IC1)
1 BC547 NPN transistor (TR1)
4 1N914 silicon signal diodes (D2-D5)
1 5.1V 400mW zener diode (D1)
6 red LEDs (DOL1-6)

Capacitors
1 100µF 25VW PC electrolytic
1 0.1µF ceramic (code 104 or 0.1)
1 22pF ceramic (code 22p or 22)

Resistors (0.25W, 5%)
7 10kΩ 1 4.7kΩ 8 390Ω
1 10Ω

slide switch on the PICFun PC board towards the middle of the unit.

Step 4

The slide switch is vital to the programming and running modes. It tells the PIC whether it is in a write (programming) or read mode. Make sure it is connected (towards middle) during programming. When running programs it must be disconnected (towards outside). Power is not applied to the PICFun2 during the programming process. The required voltage is derived from the serial interface. Power is only applied during the running process.

Step 5

Go to the Start/Programs list and run the Picplc programmer software. (NB: In the PICFun2 software setup and supplied files the term 'PIC PLC' is used to describe the device as it was originally known by that name.)

Step 6

Under Windows you open the the program in the normal manner. You'll need to tell PICFun2 which COM port you are using. The software will then transfer the sample program "model.hex" to your PICFun board.

Step 7

Test your PICFun2 programmer and micro controller. Disconnect the serial lead and jumper. Insert batteries into the holder (4 x 1.5V cells). Once power is applied the program will start to run. When the switch is pressed for a second and then released, the LEDs should light up randomly and a sound sequence be produced by the piezo buzzer.

What if it doesn't work?

OK, we'll be honest. Ours didn't work first time! Here are just a couple of the traps you could fall in to.

(1) Check your soldering and component placement. 99% of all faults with kits are found in this area. Are all the diodes and other polarised components around the right way? Have you managed to solder a bridge between adjacent pads? Have you forgotten to solder a component in (or, have you made a "dry joint")? Having exhausted all those possibilities through careful inspection and checking, let's move on to the other 1% (our problems were in the 1% category!).

(2) Is your power supply/plugpack connected the right way around? The series diode will prevent anything catastrophic happening if you connect the power back-to-front . . . but it won't work, of course!

(3) Is your 9-pin D to 9-pin D cable a true serial cable? Many of the cables have pins swapped in them (so-called "null modem" cables) and these will not work. If in doubt, check for continuity between pins with your multimeter and some short lengths of wire poked into the socket holes. Pin 1 must connect to pin 1, 2 to 2 and so on right through to pin 9. (Not all pins are used but the cable should be wired through).

Similarly, you must use a female-to-female cable. If you have a female- to-male cable with a gender changer on one end, there may be a crossover in that gender changer or cable.

(4) Have you followed the software loading/downloading steps carefully and have you properly initialized the software?

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☐	1	4.7kΩ	yellow purple red brown	yellow purple black brown brown
☐	8	390Ω	orange white brown brown	orange white black black brown
☐	1	10Ω	brown black black brown	brown black black gold brown

(5) Is the path to the hex file correct?

(6) Have you connected the correct COM port?

(7) Have you set the programming switch/jumper on the board before running the program (ie; applying power).

Where to from here?

Space does not permit detailing all the applications possible with the simple PICFun2 board – you'll find a lot more on this in the manual and on the CD-ROM.

One of the sample programs on the CD-ROM is a demonstration temperature controller, which uses the PIC to sense the temperature of a thermistor.

The thermistor, in turn, is under the influence of both a small light globe (heater) and a fan (cooler), each of which are also controlled by the PIC. This does require a few more components than what we've shown here, by the way.

A setup screen is provided on the PC through which you can enter maximum and minimum temperatures. When you download and run the program, you'll find the light comes on to heat the thermistor up to your maximum temperature, at which point the light goes off and the fan goes on to cool it back down to the minimum.

Such a demonstration board is shown separately. Sure, it's only a gimmick – but it's a great little demonstration of what a microcontroller can do and makes an interesting school project.

Just imagine if that light, thermistor and fan were replaced by a large heating, sensing and cooling system for a city skyscraper. Impossible? Nothing is impossible for a microcontroller!

Creating a program

As we said at the outset, the PICFun2 is just a starting point. Writing your own software (also known as code or a program) is not easy for a beginner – but start out simple and keep practicing – and pretty soon you could be an expert!

Microchip Technologies, the makers of PICs, have provided a number of shareware software tools for the support of their products. "MPLAB", which is downloadable from their web site (***www.microchip.com***) offers a text editor, an assembler and software simulator for the writing, assembling and testing of programs.

The text editor is used to compile the source code. This is made up of device instructions, data, directives and comments.

The program is written in mnemonic form and is based on an instruction set peculiar to the PIC device. Programs consist of a series of instructions that detail consecutively the processes the programmer requires the microcontroller to execute. Programs are set out in a special format so that labels, instructions, directives and comments are recognised by the assembler.

The assembler takes the compiled source code and processes this to produce an assembled (*.asm) file and an output (*.hex) file. The compiled source code is saved as an *.asm file while the *.hex file contains the data ready for downloading to the microcontroller.

The hex file must be loaded into a program such as Picplc to convert it into binary form first.

Debugging

It's a pretty rare programmer who manages to write code without errors, or bugs. Getting rid of these is not called squashing or swatting, it's called debugging.

MPLAB contains a software simulator which enables programs to be checked and debugged. The simulator enables programs to be observed step by step and shows what is happening in the various register and memory locations.

Simulators can be invaluable tools for program development but have their limitations since they are not the real device. For the simulator to work, a hex file must be loaded into it.

In this section we have set out some of the basics for preparing a program. We have included examples of how all three tools are used in the process. Your first step will be to install the MPLAB software if this has not already been done. About 8Mb of hard disk space will be needed. The zipped files can be saved to individual disks and installed after downloading.

And if you want more information, the web contains thousands – no, probably millions – of pages of data, programs and help on PICs as well as other microcontrollers. If you don't believe us, go to ***www.siliconchip.com.au*** and type PIC into the Google search engine. See you in a couple of years!

BitSet program

Included in the kit is a trial version of eLabtronics' "BitSet" software, an icon-based programming tool designed to replicate all the instructions available in the 16F84 instruction set. It utilises windows and drop down

menus in which all the information contained in a text instruction can be entered and implemented on variables and literals.

This provides a convenient method of entering instructions and data. The names assigned to the icons are representative of the group of functions hidden behind each button. SC

Where from?

The PICFun2 is designed by eLabtronics, 12-20 Gilles St, Adelaide, SA 5000.
Tel (08) 8231 5966 Fax (08) 8231 5266
website: www.labtron.com.au
Price of the basic PICFun2 is $78.00 +GST.
It is also available through Altronics stores and mail order (1800 999 007).

VINTAGE RADIO

By RODNEY CHAMPNESS, VK3UG

Choosing your test instruments; Pt.2

Last month in Pt.1, we looked at the most used and most common test instrument of all, the digital or analog multimeter. Most faults can be found with a multimeter but the performance of your restored radio can be considerably enhanced by the use of other test instruments.

The importance of test instruments to do the job can to a certain extent be dictated by your preferences and experience with various instruments. Generally, it is good to keep your test instruments as simple as possible and to the minimum number necessary to achieve a good result.

When I was younger and less experienced, my aim was to surround myself with as many instruments as I could afford to do the job. It gave me a feeling of importance and I also conned myself into believing that with a large selection of equipment I could find anything. However, things don't work out that way.

Not only is it desirable to have appropriate equipment, it is also necessary to know what you are looking for. In those earlier times, with only limited experience, I couldn't interpret the equipment readings or the effects of the instruments on the receiver under test. So at that time, the use of complex equipment would have been a waste of money.

RF signal generator

The two instruments that I use most today are a multimeter and an RF signal generator. I was asked by a vintage radio buff what he would use a signal generator for. He hadn't used one so naturally he was unsure of what it did and how it performed its functions.

A signal generator is very much like a miniature radio broadcast station. It is usually capable of being tuned to any frequency used by ordinary AM radio stations. It supplies a tone signal instead of voice or music, as this is easier to produce and makes it easier to gauge the performance of the radio it is attached to. It has adjustable signal level output so that it can take the place of a strong signal from a nearby station or even a weak, faraway station. It also has the advantage that it can be set to the intermediate frequency (IF) of almost any superhet radio a vintage buff is likely to see.

Having noted what a signal generator does, perhaps a few criteria for selecting a suitable signal generator can be listed:

- It may be powered from mains or batteries.
- Its radio frequency (RF) tuning range should extend from around 150kHz (the lowest IF that you are likely to see is 175kHz) to at least 30MHz when dual-wave or multi-band radios are being tested. If only broadcast band receivers are going to be tested, an upper frequency of 2MHz is all that is needed.
- It needs to have audio modulation either by a tone of 400Hz or 1000Hz, or both. If possible, the level of this tone should be adjustable and it needs to be able to be switched off.
- The audio tone should be available at the front panel and its level adjustable for testing the receiver's audio section.
- The radio frequency (RF) output level needs to be adjustable so that strong and weak signals can be simulated. This is an area that is often poorly achieved in cheap generators which are really just modulated oscillators. High-priced units have calibrated output levels so that the user can accurately determine the exact performance of their receiver.

You may have seen in some of my articles where I have quoted particular sensitivities like 10μV (microvolt), etc. This can only be done with instruments like the Hewlett Packard

This home-made audio transformer tester enables transformers to be tested for short circuited windings and turns ratio.

This high voltage insulation tester was built from an Altronics kit and is used mainly for checking the insulation of transformers.

606B shown in one of the photographs.

This facility is not available on cheap instruments as it is costly to provide. Don't despair as it isn't essential, just nice to have when a particularly tricky fault is being traced.

- The tuning dial should be accurate enough for you to be confident that the calibrations are within a few kilohertz at the lower frequencies and perhaps within 100kHz on a range up around 30MHz. This isn't precision, because vintage receivers generally have rather vague dial markings up around those high frequencies anyway.
- The signal should not drift in frequency to any extent after an initial warm-up period. For example, if you were to tune to 3RN on 621kHz on your receiver and adjust the signal generator to exactly the same frequency, there would be no beat or whistle coming out of the receiver. If, after 10 minutes, this has changed so that there is a whistle of no more than around 1000Hz, the generator is drifting a little but is OK for most purposes.

If you have to retune the generator because there is a very high tone or it is almost out of audibility, the unit really has a little too much drift and it could be a nuisance when aligning the tuned circuits in a receiver. However, this is rarely a problem.

Having set down the criteria for a signal generator, the next question is "Where do you get them?" Until recently, Dick Smith Electronics had a good general-purpose RF signal generator which was quite suitable for the job. I cannot find any generators advertised in the general electronics magazines, so where and how can a vintage radio enthusiast get such a device?

Fortunately, there are quite a few signal generators for sale at amateur radio conventions/communications days and the like, and a quite reasonable Leader LSG10 or LSG11 (such as shown in one of the photographs) can be obtained at a reasonable cost. Amateur radio equipment has become so sophisticated that generators of this standard have become of little use to amateurs.

There are of course other brands available such as Advance and Taylor in the general-purpose range and both manufacturers produced good equipment. Units like the Hewlett Packard 606B are excellent and sometimes appear on the disposals market. They are magnificent pieces of equipment but be aware some of the parts may be a hard to source if they become faulty.

Is there any other way of obtaining a signal generator? Yes, some of the old modulated oscillators that are collected by vintage radio buffs can be restored and used for their original purpose. Additionally, it is possible to build your own. Admittedly there are few designs around but back several years ago, ETI and EA did have some designs. I'm personally looking at building a relatively simple generator but it will be some time before it becomes a reality.

High voltage tester

Testing the insulation quality of power transformers, capacitors, RF transformers and other devices that rely on the integrity of insulation is important in getting the best out of a restored vintage radio. I have often laboured the point of testing the insulation of power transformers, between windings and windings to earth. It is very much a safety issue. I make no apology for this. The unit shown in the photograph is a device built from a kit put out by Altronics.

I believe that it is no longer available but a replacement kit also sold by Altronics (K2557) has been available for as low as $45. It is a SILICON CHIP design featured in May 1996 and is more versatile than the model I have.

Signal injector

This is a very simple little device that is suitable for testing valve and transistor radio equipment. It is a signal generator that puts out a basic audio frequency of 1kHz or thereabouts and harmonics of 1kHz well up into the tuning ranges of domestic radios.

It consists of a pair of transistors in a multivibrator oscillator circuit. It generates square waves at the basic frequency of 1kHz (nominally) and these are applied through a probe to RF, IF and audio circuits throughout a receiver, often pinpointing the stage with the problems.

In a set that is performing properly, applying the probe to the aerial terminal will produce a loud tone at the receiver output. By the time the probe is applied to the plate of the IF valve, the output level will be noticeably

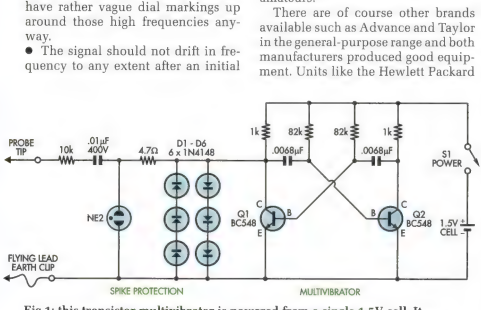


Fig.1: this transistor multivibrator is powered from a single 1.5V cell. It produces a 1kHz square signal which can be used as an audio signal while its higher harmonics can be used well up into the broadcast AM band.

lower than when it was applied to the aerial, as there is no radio frequency gain after the plate of the IF valve. Placed on the detector, a loud tone should again be heard which is controlled by the volume control, and the level will reduce as the probe is attached to audio stages nearer to the speaker.

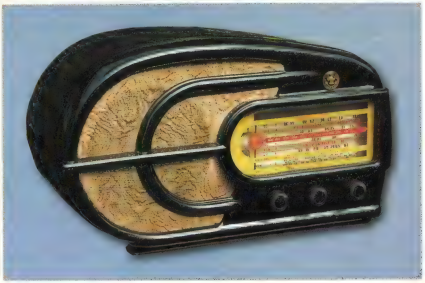
While it is a very useful little instrument, misleading results can occur due to signals getting into stages that they were not intended to get into. However, Fig.1 shows a typical circuit for readers who wish to make one. They have to be tiny. An old marker pen can be used to house it and an AAA cell, or you could use a torch shell suited for AA cells. It's tiny so a small circuit board or matrix board is needed to build it on. Some clues on construction can be obtained from the articles in the December 2000 and May 2001 issues of SILICON CHIP, on LED torches.

One precaution necessary with the signal injector is to make sure that the transistors do not receive pulses from the circuit being tested that exceed their breakdown voltage.

For example, when the earth lead is connected to the chassis and the probe is touched on the HT line, a pulse will be sent through the probe's injection capacitor (as it charges) to the collector of transistor Q1. This will exceed the breakdown voltage of the transistor and destroy it. To overcome this problem, a neon (NE2) and two strings of diodes are used to clamp this pulse to a level that will not harm the transistor.

In some circumstances, the earth lead is not needed and hand capacity is sufficient to act as an earth. Experimentation and experience will soon show you the best way to use the injector. Try it out on a few good sets first.

Photo Gallery: Peter Pan FJJ



Manufactured by Eclipse Radio, Melbourne, in 1949, the Peter Pan FJJ is a 4-valve superhet receiver employing virtually identical circuitry to a number of companion "Astor" models of the day. Housed in a substantial Bakelite cabinet and fitted with a 6-inch speaker, the Peter Pan FFJ was capable of good RF and audio performance.

Signal tracers

Just as we can inject signals into a radio and assess the results, it is quite practical to do the reverse. We can listen to the signal as it progresses through a radio with a device called a

Above: if you are going to do alignment work on vintage radios, you do need a good RF signal generator, such as this Hewlett Packard model 606B which has the advantage of a calibrated output attenuator and output metering.

Left: while many vintage radio enthusiasts would probably like to have a valve tester, this AVO MkIII Valve Characteristic Meter (Mutual Conductance Valve Tester) is really only likely to be used by someone is who designing valve circuits.

"Radio & Hobbies" magazine described the Senior Signal Tracer in May and June 1954. It is essentially a tuneable superhet radio.

Left: somewhat cheaper than the HP unit and with a good deal fewer facilities, the Leader LSG11 Signal Generator is a good instrument for vintage radio enthusiasts.

signal tracer. For example, a signal tracer can have its probe attached to the aerial terminal of a set and signals listened to at that point. Depending on the type of tracer, one or many signals (usually weak) may be heard as they don't usually have the performance of the receiver.

At the grid of the first valve, hopefully only one signal is heard, being the one the set is tuned to. In the grid or plate circuit of the IF stage, the signal will be much louder in the tracer's output. At the detector there is a choice of listening for RF or AF signals. Following the detector, the audio signal will get louder as each stage is probed with the tracer.

There are two types of signal tracer. There was an untuned type described in SILICON CHIP for June 1997 (errata on this appeared in the August issue). These units are cheap and work quite satisfactorily in tracing run of the mill faults. They are switchable from RF to AF tracing and have gain controls.

To use them, it is only a matter of putting the probe onto various signal points throughout the receiver and it will soon be obvious at which stage the signal disappears or becomes weaker instead of stronger. It is then a matter of testing that section of the set in depth to locate the fault.

A tuned signal tracer is more versatile and more expensive. In effect, a tuned signal tracer is a special superhet or TRF receiver, with attenuators to cut the gain of various stages so that it is not overloaded. It also usually has a meter to show the strength of signals as they are traced through the receiver. As the name suggests, it can tune to any of the frequencies that the set tunes to as well as the intermediate frequency (IF).

In addition, it can detect the oscillation from the local oscillator, usually without even touching any part of the oscillator circuit – just as long as the probe is near the circuit. It will also assist in determining if the oscillator is tuned to the correct frequency.

I haven't seen any of these available ready made or in kit format for many a long year. Occasionally a vintage signal tracer shows up in a collector's display. The one featured in a photograph is a *Radio & Hobbies* design from the mid 1950s. It works extremely well, being more versatile than the untuned version. A solid state version would be a much better device for today I'm sure. Regrettably the market for such an instrument is so small that it would be up to individual collectors with time on their hands to design and build such a unit.

Transformer tester

I purchased a quantity of unmarked audio output transformers. I really wasn't looking forward to laboriously testing each one with a haywire system. It would take me ages to test them all, so I did some lateral thinking and came up with a simple device which will do all the testing I needed. It will determine the turns ratio and by looking up a table, the likely impedance ratio. The inductance of the high-impedance winding and the approximate efficiency of the transformer can also be obtained on other ranges.

It uses just one quad operational amplifier IC and cost around $20 for bits. I can now test all the parameters listed above in around a minute per transformer. It is a bench instrument with an accuracy of around 10%; quite adequate for the job it is intended to do.

Oscilloscope

This is the device to use to find that really elusive fault. It can be used to measure voltages, particularly AC voltages, and is useful for looking at signal waveforms at various points throughout the circuit to determine if there is anything unusual that a multimeter cannot detect. Such things as supersonic oscillations in audio stages come to mind here. Some of these nasties occur only on audio peaks, for instance.

If you can afford it, a CRO is often well worth the money. They are excellent instruments but one that the average vintage radio restorer may turn on only once a year – just to see if it

works or to look at the pretty patterns!

Valve testers

These instruments were all the go years ago, particularly the emission testers. In reality, I found it was just as easy and usually more accurate to try a replacement valve rather than test the one from the set. They have their place but the average restorer will find little use for one.

However, if a restorer is into design work as well, the purchase of a mutual conductance valve tester will be money well spent. From the variety of readings that such an instrument can give, a very high performance piece of equipment can be designed. They are cumbersome and slow to use, and like their simpler cousins, not something most restorers would consider important to have.

Test methods

Often a fault is more readily diagnosed when replacement parts are tried in a receiver.

The most obvious and easiest to try is a replacement valve – as long as you have one of the same type, known to be good, or you can obtain one at a good price or on a loan basis. Only do this after you have determined with the multimeter that all is well as far as supply voltages are concerned. Valves at times can appear OK as far as static measurements with a multimeter are concerned but may still not work, so a replacement often cures a tricky problem. TV servicemen in the black and white days often carried a stock of known good valves to try in place of suspect valves. It saved a lot of mucking around (although it did lead to some of them being called "valve jockeys").

Strange crackles and distortion in the audio can often be cured by trying another speaker transformer and speaker on a trial basis. In the 40s and 50s, it was possible to buy a universal speaker test set. It had a multi-impedance speaker transformer which matched impedances from around 2.5kΩ ohms up to around 15kΩ, with several low impedance taps so that the various speaker impedances could be matched. It also had a choke and resistor arrangement that could match most speaker field coils.

This was a handy device in its day but is hardly necessary to deal with the occasional restoration.

Photo Gallery: Masterone 5-Valve Superhet

Made by Burnell of Perth, the Mastertone 5-valve superhet receiver used the following valve types: EK2-G frequency changer; 6D6 IF amplifier, 75 1st audio/ detector/AVC rectifier; 6F6-G output and 5Y3-G rectifier.

A spare receiver can also be used to test the local oscillator in a receiver. To conduct this test, tune another receiver to a weak station near 1000-1600kHz, with its aerial lead close to the set under test. Then slowly tune the set being tested from the 530kHz end up to around 1200kHz.

As you tune the set under test, at some point a high-pitched whistle will be heard which drops to a low pitch as you continue to slowly tune the set. It should then disappear as tuning is continued, then increase to a high pitch and finally disappear from the test receiver. If the whistle is heard, the oscillator is operating.

Going further than this by trying various replacement parts is neither quick nor effective and is not to be recommended. Get help from someone who has more experience than you have – it will save a lot of time.

Summary

So there you are, a run-down on test instruments from the essential down to the "nice to have, but don't think I'll bother" types. My order of importance, but not necessarily yours, is:
(1). Digital Multimeter (and an Analog Multimeter);
(2). RF Signal Generator;
(3). High Voltage Insulation Tester;
(4). Signal Tracer – preferably a tuned type;
(5). Signal Injector;
(6). Oscilloscope;
(7). Valve Tester – Mutual Conductance type.

Finally, while I did list the transformer tester in this article, it may not be a device that many would need, although I find it handy. **SC**

If you can afford an oscilloscope for your vintage radio work, this 2-channel 20MHz Hung Chang model from Jaycar is more than adequate for the job. (Photo from Jaycar).

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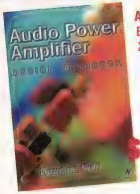

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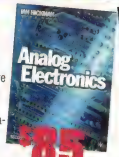

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Turbo timer false triggers

I recently bought and put together one of the Turbo Timer kits described in the November 1998 issue and it works well except for one thing. Instead of activating the relays only when the ignition is turned off, they are activated as soon as the ignition is turned on and then it switches itself off after the set time.

This means that to activate the timer after going for a long drive, you have to turn the car off, then turn it back on (timer activates straight away) then take the keys out.

I've checked and double-checked the layout. Help. (J. M., via email).

● Some vehicles do not drop the ignition voltage fast enough to trigger the Turbo Timer circuit. You can improve this by increasing the 2.2μF capacitor connecting to pin 2 of IC1 to a much larger value, say 22μF.

Coil ballast not required

I have just purchased one of the High Energy Ignition (June 1998) kits to install into a Mini Clubman. This car is not fitted with a ballast resistor in the coil circuit. Do I just ignore any reference to it on the circuit diagram? I eventually will install a Hall Effect device into the distributor.

Can I install all of the components for each of the trigger devices and use only the currently relevant input/output connections or do I have to select and install one type only and make changes when I wish to change to a different method of triggering? Any advice you can give me on these questions will be appreciated. (K. P., via email).

● Ignore the reference to the ballast. You should only install those components you need for the relevant input. If all components are installed, point A on the circuit will never be able to be pulled low by the relevant input.

Foot switches for the guitar preamp

I am building the 2-Channel Guitar Preamplifier and Digital Reverb from the November 2000 to January 2001 issues and I have a few questions.

I'll be adding a few effects boards such as distortion, twang and sustain (from Jaycar's "Short Circuits III"), the SILICON CHIP Mic/Audio Compressor and the recent Tremolo Unit. I plan to build these effects boards into the same case as the preamp and bring the in/out switches to the front panel as well as to sockets on the back for remote foot switches.

Rather than bring the circuit wiring to the foot switch sockets and to the foot switches and risk picking up hum and other noise in the leads, I intend to use mini or DIL relays to do the switching inside the preamp case and have the foot switches switch only the relays.

My question is, after the rather lengthy explanation, is there any possibility of noise or other interference coming from the relays? Are there any precautions I should take? Also, with all these extra boards (and consequential possible sources of noise), will there be much of an advantage in using the Ultra-LD amplifier module or would its predecessor, the 125W Plastic Power module (April 1996) be OK? (J. W., via email).

● We would not recommend the Ultra-LD amplifier for use with the guitar preamp. It amounts to overkill. Instead, use the plastic power amplifier which can drive 4-ohm loads.

You can use relays for the foot switch functions. Use a separate power supply for the relays so that when the relays are switched they do not induce noise into the audio. The separate power supply will need a separate transformer.

Modifying the 8-channel mixer

I was thinking of building your 8-channel mixer, as published in the November 1996 issue but have a few questions. Can I substitute the OP27 with the LM627, available from Dick Smith Electronics? Also the SSM2017 preamplifier chip is really difficult to source and as I don't require eight microphones, mostly line inputs, can

Modifying a DC-DC converter

In July 1996, you published a design for a switchmode step-up converter for use in charging SLA batteries. This used the Motorola MC34063A controller chip.

I have been endeavouring to modify the design to derive 18V at about 1.5A and with reasonable success, but some aspects still are unclear. I have only been able to download one AppNote pertaining to this chip and it did not provide the info I was seeking.

Similarly, a Motorola linear handbook did not show any series inductor/shunt external switch configurations as you used.

I appreciate that you cannot undertake design modifications for individual readers and that is not what I am chasing. What I would like, however, is a lead on any documentation you used in the preparation of this design. (P. M., via email).

● The configuration of the DC-DC converter used in the SLA battery charger is our own circuit adaptation of the MC34063. You won't find it in the Motorola application notes.

To obtain 18V you will need to adjust the divider at pin 5 so that this pin "sees" 1.25V when the output is 18V. Using a 30kΩ resistor in place of the 22kΩ resistor will give the correct divider ratio.

The inductor value used should be about right to obtain 1.5A.

I simply connect a line signal source directly to the main VR1 pot prior to IC2 in the schematic, as the LM833 can handle direct line levels? Or can you suggest a workaround?

I was hoping to add a gain control feature. Is this possible? (E. Z., via email).

● The LM627 can be used in place of the OP27 as it is an equivalent device. The SSM2017 is available from Altronics, Cat Z-2800.

You can apply line levels to the input Main level control via a coupling capacitor. This is not recommended though because of the uncertain drive impedance of the input source.

Adding a gain control is best achieved with the SSM2017 control at pins 8 and 1. Connect a 10kΩ pot in series with a 330Ω resistor between pins 8 and 1 for a nominal 25dB gain control range.

Alternatively, a gain control can be added with a potentiometer used for the gain resistors between pins 1 and 2 of IC2a. Connect one end of the pot to pin 1 and the other to ground; the wiper connects to pin 2. Some form of upper gain limit would be necessary by adding a series resistor between the end of the variable resistance and ground. When using a 10kΩ pot, the existing 2.2kΩ fixed resistor to ground would be suitable.

Dust causes TV interference

My TV is connected to an outdoor antenna and has poor reception only on ABC on "normal" days. When it is raining, the picture is as clear as a bell. On an indoor antenna, the picture is significantly better than the outdoor antenna on one of those normal days. Heavy overcast conditions also improve reception. I don't know why this is so. Perhaps you have an answer? (S. N., via email).

● It is possible that the interference is caused by dust and dirt on the insulators on adjacent high-voltage power lines. This dirt would be washed off in rainy weather, eliminating any discharge across the insulators and restoring clean reception.

If you can get the ABC on a UHF transmission, it would be well worth the investment to obtain a UHF antenna to solve this problem once and for all. Or you can build one of the SILICON CHIP UHF antenna designs (eg, see the July 1994 issue for a 4-bay bowtie array).

Fuel mixture display shows lean

I bought the SILICON CHIP Fuel Mixture display kit (from Jaycar) and hooked it to my 1994 Holden Barina GSi but the only LEDs that come on are the red ones. When I start the engine the last LED comes on but as I turn the trimpot fully to the left, only the second last LED lights.

As the car warms up, the last LED comes on and it stays that way. Is the Barina designed differently and do I need to replace the resistors with different values?

There are no solder bridges and all the LEDs are correctly positioned. What can I do? (G. E., via email).

● We are not sure what you mean by "only the red LEDs come" on as all the LEDs are red. We assume you mean that the display always shows a lean mixture, with the lower two LEDs lighting. Possibly the problem is with the adjustments of both VR2 and VR3. You need to set them as described in the adjustment section of the article.

Also check that the connection to the EGO has a good ground. Differences between the ground connection for the power supply on the fuel mixture display unit and the sensor ground can cause the display to show lean.

Supply problem in guitar preamp

I recently built the guitar preamp described in the November 2000 issue and I have a small dilemma. The power supply I have already has outputs of ±15V (really 14.38V) and when I put the power to the board it drops down to +12.1V and -11.2V and I honestly don't know why. (D. F., via email).

● We are not sure whether you are using an existing ±15V supply or the one recommended for the guitar preamplifier.

If you are using an existing supply it does not seem to be able to cope with the extra current required from it when connected to the Guitar Preamplifier circuit. You may need to use the recommended power supply.

If you are using the recommended power supply, then there does seem to be a problem with its output voltage at no load. The voltage should be closer to 15V than the 14.38V you are obtaining. We would envisage the power supply to deliver at least ±14.8V under no load. Perhaps the regulators are faulty?

Train detector for outdoor work

I need a model train detector that works outdoors. I tried ultrasonics – the wind defeated that. IR – the sun beats me there. RF (radar) – there are kids about and some people want more.

The only one that I can think that may work is a metal detection type. HF across the rails won't work with DCC systems and some of us run live steam and battery power.

By the way, the white LED torch has another use. I made one for my niece who goes scuba diving. She did not like the cost of a decent diving torch, so I made one up with a couple of NiMh C cells, 10 5mm white LEDs and an inductive charger (bits and pieces of your previous projects jumbled together), all in an old Dolphin-like (smaller) torch case. I then filled the case, after testing, with casting resin, lens area and all.

She now has one solid, pressure proof and near indestructible diving torch that throws a good beam and lasts a long while. I wonder how long it will be before headlights are made of white LED arrays? (R. P., via email).

● We've done two train detectors that will work outdoors, in April 1994 (a Hall effect sensor) and a 25kHz system in June 1995. We can supply these issues for $7.70 each, including postage.

Thanks for the information on the diving light.

Voltage droop when connecting the circuit to the supply usually means there is a short circuit somewhere on the PC board. This could be shorted pins on one of the op amps or a fine solder whisker joining tracks. Check with a magnifying glass on the underside of the PC board. Also do a close comparison between the published PC artwork and the copper tracks for solder bridges which should not be there.

Diode for white LED

We are very interested in producing the white LED torch as described in the May 2001 issue but we are having trouble locating the Schottky diode (BYV10-20). We have inquired at numerous electronics outlets including Jaycar, Altronics, Dick Smith Electronics and other outlets in Melbourne. (A. H., via email).

● The Schottky diode for the LED torch does not need to be the BYV10-20. You can use the 1N5819 which is available from (Jaycar ZR-1020), (Dick Smith Electronics Z-3250) and (Altronics Z-0040). By the way, the BYV10-20 diode is also available from Farnell. Phone 1300 361 005.

4-ohm loads for class-A amplifier

I have built the 15W class-A amplifier described in the August 1998 issue and am pleased with its performance. The specs state that it is rated at 15W into 8Ω. Can you tell me what it is likely to achieve into 4Ω?

Also is it possible to increase the output by paralleling the output transistors and increasing the power supply? (S. F., Lake District, UK).

● You can operate the class-A amplifier with 4-ohm loads and it will probably deliver about 25-30 watts maximum. The only problem is that once the load current exceeds about 1.9A peak, the amplifier will no longer be in class A. Instead it will be in class AB (albeit with exceedingly low crossover distortion artefacts) for power levels above 7.5 watts.

While we have not looked closely at the biasing, if you wanted to run in class-A up to full power, you would need to double the quiescent current. You would not need to double up on the output transistors but you would need a fan cooled heatsink to cope with the 80-watt dissipation and you would need a bigger power supply.

Charging two sets of AAA cells

I have a Kodak MC3 digital camera and MP3 player. They each use three AAA batteries and buying new disposable batteries all the time is impractical and expensive. I need a charger that can fast-charge two lots of three AAA batteries at a time. Could you suggest a kit that can or a product I could buy? (A. T., Wagga Wagga, NSW).

● The Fast Universal Charger published in the June & July 2001 issues will charge 3.6V Nicads or NiMH batteries (ie, it can do three AAA nicads in series) but it could not do two sets at one time because it could not properly monitor the "end-point" voltage of each set.

More IRLEDs for remote control extender

Could you let me know if it is possible to run more than one IRLED on the remote control extender featured in the July 1996 issue. If so, what do I have to do so it still works. I need to do this because I have two units in

WARNING!

SILICON CHIP magazine regularly describes projects which employ a mains power supply or produce high voltage. All such projects should be considered dangerous or even lethal if not used safely. Readers are warned that high voltage wiring should be carried out according to the instructions in the articles. When working on these projects use extreme care to ensure that you do not accidentally come into contact with mains AC voltages or high voltage DC. If you are not confident about working with projects employing mains voltages or other high voltages, you are advised not to attempt work on them. Silicon Chip Publications Pty Ltd disclaims any liability for damages should anyone be killed or injured while working on a project or circuit described in any issue of SILICON CHIP magazine. Devices or circuits described in SILICON CHIP may be covered by patents. SILICON CHIP disclaims any liability for the infringement of such patents by the manufacturing or selling of any such equipment. SILICON CHIP also disclaims any liability for projects which are used in such a way as to infringe relevant government regulations and by-laws.

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Dr Video not good on latest Macrovision

I recently constructed two Doctor Video kits from the April 2001 issue and have since tried to use them only to find that although they do help they don't work fully.

I tried to copy my Star Wars trilogy set so as to keep the originals in perfect condition. I found that it helped stop some of the horizontal tearing in the picture but not enough to stop all of the colour and horizontal problems. Can you help? (P. C., via email).

- It sounds like the tape you want to copy has the very latest version of Macrovision which is designed to be much harder to remove than the earlier versions. If so, the Dr Video box won't be able to give clean enough video.

As far as we know, there isn't any complete fix for the latest Macrovision – luckily it hasn't been used on too many movies yet but that may quickly change.

different places. (R. S., via email).

- You can run another IRLED via a separate 220Ω resistor connected to transistor Q1.

Ignition circuit runs hot

I have built the High Energy Ignition described in the June 1998 issue. It works well but the case gets very hot. I checked the current draw which was around 4A at idle, dropping to 3A when I revved the engine.

All this seems OK but I am just a bit concerned that it runs so hot; I can't keep my hand on the case. (P. C., via email).

- Paradoxically, it is the current limiting which causes the circuit to run hot. If you want to check that your circuit is running properly. Short out D3 to disable the current limiting. The case should now run just warm to the touch; if it is still hot, you have a fault.

Another possibility is that the case is too close to the engine. It is best to mount the case away from exhaust manifolds and preferably where air can pass over it.

Cooler not cold enough for beer

I have built the Switching Temperature Controller described in the August 1999 issue but cannot get it to regulate the temperature below 10°C; not cold enough for my beer. I am a pommy but not that much. It was built using the Oatley kit. The Esky can cool to -1°C by removing the thermistor from the circuit. Please help! (Andrew, via email).

- If the circuit can cool to below 1°C without the thermistor, we suggest you connect a 100Ω resistor in series with trimpot VR1. This will compensate for any tolerance variation in the thermistor.

It seems likely that either there is a wide spread in the thermistor tolerances or a different thermistor has been supplied in the kit.

Notes & Errata

Audio/Video Distribution Amplifier, November 2001: the 12 47kΩ resistors for the audio distribution outputs should be changed to 1kΩ. This is to avoid undue treble loss due to long cables. Though not essential, to ensure an extended bass response down to 20Hz with all six outputs in use, increase the output coupling capacitors from 0.39µF to 1µF.

Programming Adapter for AVR Microcontrollers, October 2001: Fig.1 on page 69 shows the optional programming indicator connected to ground. The LED polarity should be reversed and connected to +5V.

Universal Fast Battery Charger, June & July 2001: in some cases, transistor Q2 turns on slightly even though the unit is not in Refresh mode. The cure is to install a 1N4148 or 1N914 diode in series with Q2's base (anode toward pin 10 of IC1). This diode can be installed in place of the link connecting pin 10 of IC1 to the base of Q2.

Low Ohms Adaptor for DMMs, September 2001: the Circuit Notebook item on page 68 shows a GND terminal on the LM317. It should be labelled ADJ. SC

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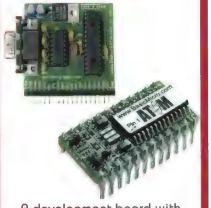

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